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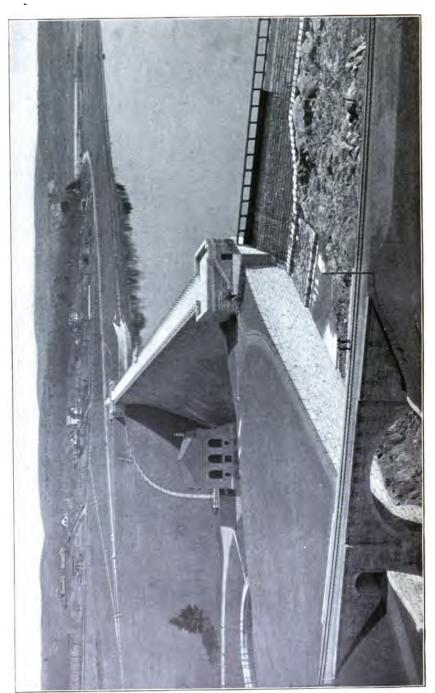




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WACHUSETT DAM WITH FULL RESERVOIR.



# SEVENTH ANNUAL REPORT

OF THE

# METROPOLITAN WATER AND SEWERAGE BOARD

FOR THE YEAR 1907.



#### BOSTON:

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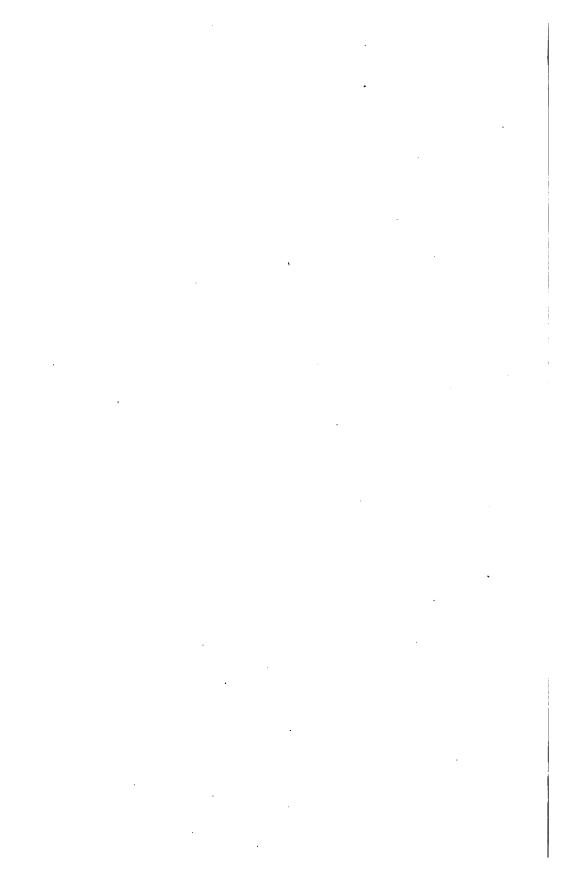
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# METROPOLITAN WATER AND SEWERAGE BOARD.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan Water and Sewerage Board, established under the provisions of chapter 168 of the Acts of the year 1901, has already presented to your Honorable Body an abstract of the account of its doings, receipts, expenditures, disbursements, assets and liabilities for the fiscal year ending on November 30, 1907, and now, in accordance with the provisions of chapter 235 of the Acts of the year 1906, it presents a detailed statement of its doings for the calendar year ending on December 31, 1907, being its

#### SEVENTH ANNUAL REPORT

made since the consolidation of the Metropolitan Water Board and the Board of Metropolitan Sewerage Commissioners on March 20, 1901.

#### I. ORGANIZATION AND ADMINISTRATION.

## (1) Board, Officers and Employés.

The term of office of James A. Bailey, Jr., expired on March 21, 1907, and he was reappointed for the three years next succeeding. The membership of the Board has consequently remained as in the preceding year: Henry H. Sprague, chairman, Henry P. Walcott, M.D., and James A. Bailey, Jr. William N. Davenport has continued as secretary and in charge of the auditing department. Alfred F. Bridgman has been the purchasing agent, and Miss Bertha M. Briggs the book-keeper.

There are also employed in the administrative office a paymaster, an assistant in auditing, two general clerks, three stenographers and clerks, a telephone operator, a messenger, and a janitor with two assistants, one of whom acts as watchman.

George D. Bigelow has been in charge of the conveyancing work, and he has been assisted by Miss Alline E. Marcy, title examiner. They have performed such general conveyancing work, and such further investigation of real estate titles in the different counties as has been called for during the year.

Frederic P. Stearns continued to hold the position of Chief Engineer of the Board until February 1, 1907, although, on account of being unable to give more than a part of his time to the Board, much of the active supervision had devolved upon Dexter Brackett, the Engineer of the Sudbury and Distribution departments. On that date Mr. Stearns' resignation as Chief Engineer was accepted.

In recognition of his services, the Board caused the following entry to be made upon its records:—

The members of the Board, in regretfully accepting the resignation of Mr. Stearns as Chief Engineer, desire to express and record their appreciation of the value and excellence of his service in connection with the Metropolitan Water Works. Having assisted as Engineer of the State Board of Health in the inception of the scheme for securing to the District an additional water supply, he entered upon his service with a ripe experience; he displayed rare foresight and wisdom in the maturing of the plans for carrying out the undertaking; and he prosecuted the details of construction with zeal and fidelity until the greater works contemplated for the earlier period, which has now elapsed, have been successfully completed. For the intelligence, skill and devotion which he constantly exercised, and for the thoroughness, economy and efficiency which he achieved, the Commonwealth owes him a deep obligation.

Mr. Stearns was at the same time made a consulting engineer of the Board, and is retained with Joseph P. Davis and Hiram F. Mills for consultation in such matters as may arise requiring consideration.

Dexter Brackett was appointed Chief Engineer of Water Works, with supervision of the various departments. William E. Foss and Alfred O. Doane have continued as Division Engineers, Benjamin F. Hancox as Assistant in charge of the Drafting Department, and Samuel E. Killam as Office Assistant.

There has been a slight reduction in the engineering force employed in construction upon the Water Works, but some addition has been required in the number employed upon the maintenance and operation of works. The average force in construction and maintenance during the year has included, in addition to the Chief Engineer, 5 division engineers, 6 assistant engineers, and 36 others in various engineering capacities and as sanitary inspectors, clerks, stenographers and messengers, the total force numbering 47. The maximum engineering force employed at any one time during the year on both construction and maintenance was 50.

A maintenance force, in addition to those engaged in engineering capacities as above mentioned, numbering upon the average during the year 234, has been required at the pumping stations and upon the reservoirs, aqueducts, pipe lines and other works. At the end of the year this force numbered 203.

Day laborers have in addition been employed from time to time in connection with the regular force as their services were required.

William M. Brown has continued in charge of both construction and maintenance of the Sewerage Works during the year. On February 1, 1907, his title was changed to that of Chief Engineer of Sewerage Works. He has been assisted during the year by Frank I. Capen, Seth Peterson, Frederick D. Smith and Frank A. Emery (part of the year), division engineers, who have been in supervision of both construction and maintenance departments, by 5 assistant engineers and 22 others employed in various engineering capacities, and by one clerk and stenographer.

The maximum engineering force employed at any one time during the year on construction and maintenance of Sewerage Works was 28.

The regular maintenance force required in addition for the operation of the pumping stations, the care and inspection of the sewers and for other parts of the Sewerage Works, exclusive of the engineers and day-labor forces, has upon the average numbered 140.

The whole regular force of the Sewerage Department at the end of the year numbered 168, of whom the Chief Engineer and 27 assistants and draftsmen were engaged in general upon the works, and, of the remainder, 83 were employed upon the North System and 57 upon the South System.

Day-labor forces under the supervision of the engineers and the immediate direction of foremen have been employed in the construction of the pneumatic tunnel on Section 80 of the High-level Sewer extension in West Roxbury and in the construction of a rock and earth tunnel in Brighton on Section 85.

The maximum number of men employed upon contracts and upon day-labor construction on the Sewerage Works during the year was for the week ending August 10, when the number amounted to 468.

#### (2) Offices and Buildings.

The offices of the Board and of the secretary, the auditing and conveyancing departments, and the main engineering offices of both Water Works and Sewerage Works are located in the buildings numbered 1 and 3 Ashburton Place, at the corner of Somerset Street.

A branch office for the Wachusett Department of the Water Works is maintained at Clinton, and for the Sudbury Department at South Framingham. Headquarters of the maintenance force of the Water Works for the northern part of the Metropolitan District are maintained in the Glenwood pipe yard in Medford, where there are offices, shops, store-rooms and stables; and the maintenance force for the southern part of the District has headquarters in like buildings at the Chestnut Hill Reservoir.

Branch headquarters of the maintenance and repair forces of the Sewerage Works are maintained for the North Metropolitan System near the East Boston pumping station, and for the South Metropolitan System at the Ward Street pumping station and at the storage yard at Hough's Neck.

#### (3) Conveyancing.

The conveyancing work required for the Water and Sewerage Works has occupied but a part of the time of the conveyancer and his assistant.

The settlements made by the Board affecting real estate were 52 in number, and have called for the revision and bringing up to date of the titles involved and the preparation of the various papers which have been required. Of these settlements, 17 were on account of lands and easements acquired by the Board, and these affected a total area of 46.58 acres.

Examination of the titles of 19.10 acres of additional land acquired during the year has been required, and besides 12 instruments of taking have been drafted and recorded. Of these takings, 7 were

for the Water Works and covered land which had been previously acquired by deed, amounting in all to about 347.62 acres. The 5 takings of land for the Sewerage Works were for the High-level Sewer extension in Brookline, and they amounted in fee and in easements to 12.66 acres, none of which had been previously acquired.

#### II. METROPOLITAN WATER DISTRICT.

The Metropolitan Water District now comprises the cities of Boston, Chelsea, Everett, Malden, Medford, Melrose, Newton, Quincy and Somerville, and the towns of Arlington, Belmont, Hyde Park, Lexington, Milton, Nahant, Revere, Stoneham, Watertown and Winthrop,—in all, 9 cities and 10 towns. The District has an area of 171.7 square miles, and its population, as of the date of July 1, 1907,—the date upon which calculations for the Water Works are based,—is estimated at 980,900.

The town of Swampscott, having an estimated population of 5,510, although it is outside of the Metropolitan Water District, is supplied with water by a special arrangement made with the Board.

The city of Newton and the town of Hyde Park, however, though belonging to the District, do not take water from the Metropolitan sources, but still depend upon their own sources of supply.

#### III. METROPOLITAN WATER WORKS - CONSTRUCTION.

The total amount expended for construction, including real estate acquired and payment of claims on account of the Water Works, during the calendar year 1907, was \$188,631.02. Of this amount, \$99,592.35 was expended on account of the Wachusett Dam and Reservoir; \$3,359.13 on account of the Weston Aqueduct and Reservoir; \$19,370.72 for the improvement of the Wachusett watershed; \$3,391.30 on account of the diversion of the waters of the South Branch of the Nashua River; \$56,199.06 for construction in the Distribution Department; and the remainder, \$6,718.46, for administration and other expenses. The total amount expended on account of construction since the beginning of the Water Works in the year 1895 has been \$40,467,508.04.

#### (1) Wachusett Dam and Reservoir.

#### (a) Wachusett Dam.

A small amount of construction work has been done during the past year in connection with the Wachusett Dam.

Machinery for lighting, pumping and hoisting in the gate or power house has been obtained and set up in the house. The temporary wooden floor in the main room has been raised to its permanent level, but it is not contemplated to construct a permanent tile floor until the power plant, if determined upon, shall be installed. Appliances have been introduced for measuring and recording the amounts of water flowing into the Lancaster Mills pond and furnished to the Lancaster Mills. Some work has been done in pointing the joints of the up-stream face of the dam.

#### (b) Wachusett Reservoir.

In anticipation of the complete filling of the reservoir, it was deemed necessary to remove the weeds, grass and shrubs which had grown up, since the original stripping of the bed of the reservoir, upon the upper portions of the reservoir site where the water had not yet reached. There was thus cleaned up an area of about 1,130 acres.

The rising of the water of the reservoir, in connection with the action of the wind and rain and frost, has caused a caving in of the steeper banks in several places along the shores, and a consequent retreating of the margin to the original limit of the soil stripping. In such places further cleaning and removal of the soil have been found necessary, and for a total distance of about 4,600 feet the organic material has been further removed to a width of from 10 to 40 feet.

The steep bank on the northwesterly side of the reservoir beyond the waste-way of the dam, which had been covered with gravel, has been further protected from the action of the waves by the laying of riprap for a distance of about 265 feet.

On April 11 there occurred at the North Dike a slide of a portion of the material, composed of sand, gravel and riprap, which constitutes the facing or embankment sloping toward the reservoir. The portion of the dike affected was about 700 feet long, where the dike is about 80 feet high and has a thickness at the base of 1,930 feet.



WACHUSETT RESERVOIR-VIEW FROM NORTHWESTERLY END OF THE WACHUSETT DAM.



• . This facing, which had been placed of varying thicknesses against the water-tight core of the dike, had at this point a slope of 2 horizontal to 1 vertical, and the water had thus far risen against it to a depth of about 42 feet. The slide did not affect the stability of the dike proper, but did show the importance of lengthening the slope of the outer gravel facing approximating to that which is made by the natural action of the water.

It was therefore deemed advisable in making the necessary repairs to reenforce the embankment against the water of the reservoir, not only at the point where the slide occurred, but in other places, by extending the original decline of 2 to 1 to a slope of 4 and 5 horizontal to 1 vertical. The embankment has thus been strengthened at five different points along the westerly portion of the dike, aggregating a length of 1,560 feet. The necessary material was taken from the bed of the reservoir, and the rock for the riprap has been obtained from quarries on the land of the Commonwealth. All the labor has been performed by men and teams employed under the direct supervision of the Superintendent of the Wachusett Department, except for the laying of the heavy riprap, which was done under contract. The entire work had been completed at the end of the year except the laying of a small portion of the riprap. The cost of the work will be apportioned between construction and maintenance, that estimated for reenforcement and strengthening of the dike to construction and the remainder to maintenance.

A map of the completed reservoir, showing the water line and the marginal property line, and the positions of the more prominent points included in the area, has been prepared and accompanies this report.

## (c) Location, Construction and Discontinuance of Roads.

No new highways have been laid out during the past year, and but one highway has been discontinued, a description of which is as follows:—

Discontinuance of	ŧ	Road	in	the	Year	1907.
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No.	Location.	Description.	Date of Discontinuance.
27	Sterling,	That part of the road formerly leading from Sawyer's Mills to Sterling, extending northwesterly from the portion of said road already discontinued to the new highway from West Boylston to Clinton.	January 18, 1907.

#### (d) Clinton Catholic Cemetery.

As stated in previous annual reports, all the work required to be done under the agreement made with the Roman Catholic Bishop of the Diocese of Springfield, the St. John's Catholic Cemetery Association of Clinton, and the Board, by which lands were to be acquired in the southerly part of the town of Lancaster for a new cemetery and the bodies were to be removed from the old cemetery to the new cemetery site, has long been accomplished. The soil on the site of the old cemetery was stripped and removed, and the land has been embraced in the reservoir limits, while the new cemetery has long been in general use.

The Board has repeatedly, but without success, asked for the final performance of the stipulations of the agreement, that on the completion of the work the Bishop, who holds the title, shall convey to the Commonwealth the old cemetery lot, with a release of all claims for damages, and thereupon the Board is ready to convey the lands in Lancaster, to which the Commonwealth holds title, to the St. John's Catholic Cemetery Association, and to pay to the Association the balance of money, amounting to \$32,096.83, due from the Commonwealth, all as required by the agreement.

# (e) Engineering Work about Wachusett Reservoir.

During the past year the survey of the marginal line of the watershed of the Wachusett Reservoir has been completed and the entire area ascertained. The length of the marginal line is determined to be 78.93 miles, and the area of the watershed above the dam to be 118.90 square miles.

Lines have been drawn upon the record plans showing the contour of the area or bottom of the reservoir, completing the work except in the places where there have been recent changes at the shores. Subject to slight revision, the area of the reservoir has been fixed at 4,135.32 acres, or 6.46 square miles, and the capacity of the reservoir has been calculated to be 64,968,000,000 gallons.

#### (2) IMPROVEMENT OF WACHUSETT WATERSHED.

#### (a) Sterling Filter-beds.

The four filter-beds designed to divert and filter the waters of a brook which runs through the village of Sterling Centre, whose construction was begun in September, 1906, were completed during the fore part of the past year. They were put into operation on May 23, and since that time the entire water of the brook, which receives the overflow of some of the cesspools in the village, and other polluting matter, has been filtered by passing through the beds. The cost of construction was \$14,221.28, and the sum of \$1,060 was paid for land damages.

#### (b) Sterling Junction Filter-beds.

The sewage and drainage of several summer cottages and a boarding house near the Sterling Methodist Camp Grounds had been conveyed to a cesspool near the West Waushacum Pond, from which there was a frequent overflow, so that polluting matter often found its way into the pond and thence was received into the Wachusett Reservoir. To remedy this trouble four small filter-beds, having a combined area of 1,200 square feet, have been built, and all the drainage from these houses is now filtered before entering the pond and being thence discharged into the reservoir. They were put into operation on September 16, but their maintenance will not be required in the winter months. The cost of construction was \$541.13.

# (c) Drainage of Swamps.

The construction of ditches for the drainage of the swamp on Governor Brook, situated in the towns of Holden and Princeton and tributary to the Quinepoxet River, had been begun in the preceding year. The work was resumed early in the past year, and was completed near the end of the season.

This swamp has an area of 220 acres and a watershed of about 1,625 acres. The total length of the ditches constructed for its drainage was 27,661 feet, of which 23,064 feet, or 4.37 miles, were built during the past year, at a cost of \$10,647.

The total length of ditches constructed for the drainage of swamps on both Trout and Governor brooks in the two towns in the past two years was 57,812 feet, or 10.95 miles.

#### (d) Miscellaneous Improvements.

The low intervale land along the Quinepoxet River above the reservoir, which is flooded at times of heavy rains, has to the extent of about 14 acres been cleared of the brush and dead and decaying wood, and has been burned over so as to prevent, so far as practicable, the washing of undesirable matter into the reservoir.

At Dorr's Mill and Warfield's Mill, both situated above the reservoir on the Quinepoxet River, properties which have been acquired by the Commonwealth, the remaining walls of buildings have been taken down, the cellars filled or cleaned up, and the grounds put generally into a sanitary condition. The old farmhouse, cottages and barns at the Gates farm on Middle Waushacum Pond have all been taken down and removed. Several cesspools and a vault have been built in the town of Sterling for preventing the pollution by barn, sink and privy drainage of the water flowing into the reservoir.

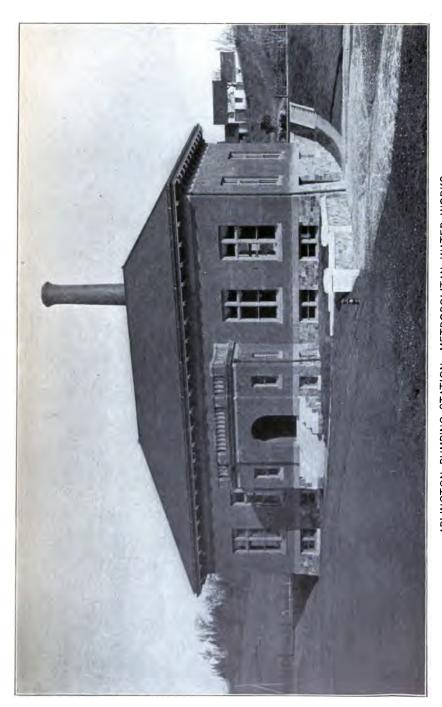
#### (3) Pumping Stations.

## (a) Chestnut Hill Pumping Stations.

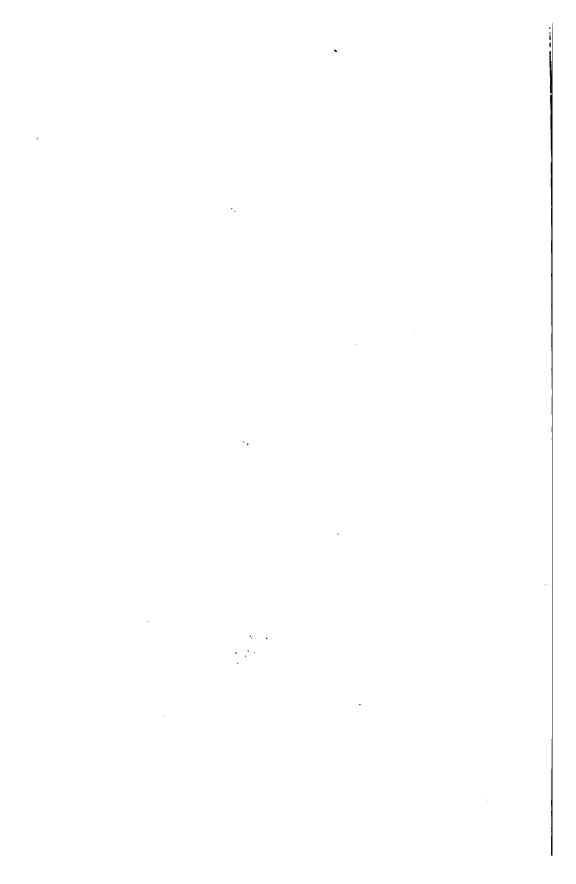
A new boiler at the Chestnut Hill high-service pumping station, of a design the same as that of the two boilers obtained in the year 1901, was contracted for and has been installed, and has added much to the efficiency of the high service. The cost of the boiler as delivered at the station was \$2,976.

## (b) Arlington Pumping Station.

The new Arlington pumping station, which had been about half constructed in the year 1906, has been fully completed during the past year. The main building is 90 feet long and 46 feet wide, and has a height of 26 feet from the surface of the ground to the cornice. The foundations are of concrete surmounted with seam-faced granite, and the exterior walls are of dark-red brick with brownstone trimmings, and are covered with a hip roof. The brick chimney has a height of 70 feet and a diameter of 8 feet at its base. The engine and boiler rooms have interior facings of red brick, the



ARLINGTON PUMPING STATION-METROPOLITAN WATER WORKS.



floor of the former being of red tiles and of the latter granolithic. There are an office and a toilet room, and there is also a large underground coal pocket, over a part of which extends a side track from the main line of the railroad, so that coal may be delivered from the cars directly into the station. Considerable grading of the grounds about the station has been required.

The pumping engine, which had been contracted for, was installed and was put into operation near the end of the year. It had been intended to remove to the new station and to put into operation one of the old pumping engines formerly belonging to the town of Arlington, but it was found that it was incapable of prolonged use, and a contract was made for a second engine. This engine, which has, like the other, a capacity of pumping 1,500,000 gallons per day, will be completed early in the coming year. Two boilers with the necessary settings and connections have been installed.

In making the detailed plans for the building it was determined to be desirable to construct a building of larger size and more stable character than had been originally intended, in order to make a proper provision for the future for the district supplied from the station, which at the present time comprises a portion of the town of Arlington and the town of Lexington. The total cost of the building, machinery and equipment has thus far been \$47,473.95.

#### (4) IMPROVEMENT OF SPOT POND BROOK.

No action has been taken during the year under the petition brought by the city of Melrose for the appointment of commissioners under chapter 406 of the Acts of the year 1904, which was an act "to provide for the improvement of Spot Pond Brook by the Metropolitan Water and Sewerage Board."

# (5) Acquisition of Lands and Settlements for Lands Acquired.

The Board acquired during the past year by purchase 19.10 acres in fee, situated in West Boylston, being that part of the Oakdale Park land on the northwesterly side of Pleasant Street which had not been previously acquired by the Board. No new land has been acquired by taking.

The total area of all the lands acquired for the Metropolitan Water Works since the beginning of operations in the year 1895 has

amounted to 16,833.83 acres, or 26.28 square miles. The number of takings of land made during the year was 7, all of land supposed to have been already acquired by deed.

List of Takings for Metropolitan Water Works for the Year 1907.

No.	LOCATION AND DESCRIPTION.	Former Owners.	Record	ed.	Purpose of Taking.
115	West Boylston, —6 parcels, one on Lancaster Street, one on Lancas- ter and Sterling streets, one east- erly of the southwest end of Lancaster Street, two on opposite sides of the new highway to Oak- dale, and one easterly of Worces- ter Street on the side of the Worcester, Nashua & Rochester Railroad. Area, 74.96 acres, in	Ada A. Whittemore, Mary E. Cook, de- visees of Lorenzo Butler, George H. Holmes and Louis W. and Arthur H. Sawyer.	1907 Feb.	'• <sub>7</sub> .	Wachusett Reservoir
116	fee. West Boylston, — the Oakdale Park land on the northwesterly side of Pleasant Street and on the Worcester, Nashua & Rochester Railroad. Area, 19.10 acres, in fee.	Inhabitants of the town of West Boylston.	Мау	18.	Wachusett Reservoir
117	Clinton, Sterling and Boylston,— 2 parcels in Clinton, one on Prospect and Walnut streets, the other on Boylston Street, a parcel in Sterling on the old road to Sawyer's Mills, and two in Boylston, one on the new highway to Clinton and the other on the old road to Sawyer's Mills and a cross road; also, 2 parcels within adjoining roads. Area, 22.035	Walter R. Dame, Thomas Ellis, de- visees of Thomas H. O'Connor, George Hazard and Aime Gre- goire.	Nov.	29.	Wachusett Reservoir
18	acres, in fee. Framingham, Wayland and Weston,—in Framingham easterly from Edgell Street, in Wayland easterly from School Street, and in Weston on River and Loring streets. Area, 13.52 acres, in fee.	Saxonville Mills, Abbie F. Nogler and Laura S. Wil- kinson and others.	Dec.	8.	Weston Aqueduct.
19	Natick,—southerly of Fisher Street on the Saxonville Branch of the Boston & Albany Rail- road, with right of way to Fisher	Clement P. Soley.	Dec.	3.	Improvement of Lake Cochituate.
20	Street. Area, 2.95 acres, in fee. Holden,—the "Canada Milla" property on River and Holden streets, and the "Dorr Milla" property on Quinepoxet River and the Boston & Maine Rail-	The L. M. Harris Manufacturing Company and James Dorr.	Dec.	81.	Improvement of Wa chusett Watershed.
21	road. Area, 204.17 acres, in fee. Sterling and West Boylston,—the Palmer Wagon Company property on Fairbank and Loring streets, and a new highway. Area, 10.88 acres, in fee.	Walter B. Sawyer and William M. Bruce.	Dec.	31.	Improvement of Wachusett Watershed.

Settlements under purchases and takings of land, for all purposes of the Water Works, have been effected in the past year in 14 cases, and for an aggregate of 46.24 acres, with the buildings thereon. Of these cases, 6 were on account of the Wachusett Reservoir, 4 on account of the Weston Aqueduct, 3 for the improvement of the Wachusett watershed, and 1 for the low service pipe line in Med-

ford. The sums paid in all these settlements during the year 1907 have amounted to \$10,829.49. In 3 of these cases the settlements have been results of suits at law, and the total amount paid in the court settlements during the year 1907 has been \$2,240.49. Payments "on account" previously made would make the total amount paid in these 3 cases \$3,518.56.

Since the beginning of operations upon the Metropolitan Water Works, the number of settlements effected on account of the acquisition of lands for the purposes of the Water Works, including the works of water supply acquired from the city of Boston on January 1, 1898, has amounted to 881; and under them the Board has acquired rights, in fee or easements, in 16,538.12 acres, or 25.84 square miles, for which an aggregate of \$18,257,848.72 has been paid. Only 51 of these cases have been settled by judgments obtained in court, and the total amount paid under these judgments has been \$1,390,270.15, or less than 8 per cent. of the whole amount paid.

Of the lands acquired, either in fee or in easement, since the beginning of operations upon the Metropolitan Water Works, settlement has been effected with the owners of all these lands except 2.61 acres. This amount does not, however, include 69.75 acres in Lancaster, which the Board stands ready to convey to the St. John's Catholic Cemetery Association; and 38.79 acres of land in Clinton, of which the owners have not been found.

Not including the settlement with the city of Boston, which was effected by agreement out of court, and the settlement with the cities of Malden, Medford and Melrose for Spot Pond and surrounding lands, which was made upon the basis of an award by commissioners, the Board has obtained settlement by voluntary agreement with <sup>17</sup>/<sub>18</sub> of all the owners of the lands acquired, and almost <sup>13</sup>/<sub>14</sub> of the total amount of money paid in settlements was under voluntary agreement with the owners.

The above purchases and takings for which the settlements have been made include lands taken in fee with the buildings thereon and the water and other rights connected therewith, and lands in which easements and other rights are taken; but they do not include settlements for diversion of water, depreciation and other damages connected with lands not acquired, and in which no fee or easement has been taken.

#### Summary of Land Settlements for Water Works to December 31, 1907.

				Fo	R THE YEAR	1907.	FROM BREINNING OF WORK.				
LOCATI	ON.			Area in Acres.	Number of Settle- ments.	Payments.	Area in Acres.	Number of Settle- ments.	Payments.		
Wachusett R	eseri	oir.									
Berlin,				-	h		16.700	h			
Boylston, .				-	11		4,008.116				
Clinton,				1.269	_		1,276.284				
Holden,				-	6	\$6,679 00	167.000	441	\$2,958,859 1		
Sterling,				-	il		797.987	li			
West Boylston,				80.573	IJ		1,688.497	J			
Total, .	•	•		81.842	6	\$6,679 00	7,944.584	441	\$2,958,859 1		
Improving Wach		Wa	ler-								
Holden,				_	h		151.840	h			
Sterling,				8.590	} 3	\$1,060 00	287.740	} n	\$184,520 0		
West Boylston,				-	IJ		64.480	J .			
Total, .				8.590	3	\$1,060 00	458.510	11	\$134,520 0		
Wachusett A	qued	uct.									
Berlin,	•	•	•	-	h		47.815	h			
Clinton,	•	•		-			12.810				
Marlborough, .	•	•		• -	} -	-	51.580	70	\$81,677 0		
Northborough,	•	•		-			89.000				
Southborough, .		•		-	J		108.660	}			
Total, .	•	•		-	-	-	309.815	70	<b>\$81,677</b> 0		
Sudbury Re	ervo	ir.1						,			
Marlborough, .	•	•	٠	-	} _	_	751.980	} 158	<b>\$658,318</b> 7		
Southborough,	٠	•	•		)		2,019.080	5 200	<b>\$000,010</b> 1		
Total, .	•	•	•	-	-	-	2,771.060	158	\$658,318 7		
Improving Sudd shed	ury	Wat	er-								
Ashland,		•		-	ì		.630	1			
Marlborough,	•			-			.800				
Northborough,		•	.	-	[		178.049	,.	<b>410 700 3</b>		
Sherborn, .				_	][ -	_	1.000	41	\$16,522 1		
Southborough,				_			4.829				
Westborough,		•		-	IJ		205.487	]			
Total, .				_	-		390.795	41	\$16,522 1		

<sup>&</sup>lt;sup>1</sup> Including settlements made by city of Boston.

# Summary of Land Settlements for Water Works, etc. — Continued.

					Fo	R THE YEAR	1907.	From	Beginning	OF WORK.
Loc	AT	ION.		i	Area in Acres.	Number of Settle- ments.	Payments.	Area in Acres.	Number of Settlements.	Payments.
Clinton Ser	o <b>er</b> a	ige S	yster	n.						
Clinton, .			•		_	)		5.815	<b>b</b>	
Lancaster,					-	} -	-	129.835	36	\$37,794 40
Total,	•		•	•	-	-	-	185.150	36	\$87,794 40
Weston	Aq	uedu	ict.		:				i	
Framingham,					4.690	h		107.335	h	
Newton, .	•				-			1.308	il .	
Southborougi	1,				-360	} 4	\$2,290 49	.810	90	\$187,161 96
Wayland,			•		-			78.299		
Weston, .			•		.720	J ·		295.915	IJ	
Total,	•	•	•	•	5.770	4	\$2,290 49	478.667	90	\$187,161 96
<b>Distri</b> bu	tion	Syst	tem.							
Arlington,					-	h		1.896	h	
Boston, .					-			1.359		
Brookline,					_			.051		
Malden, .					-			.158	1	
Medford, .					.038			8.251		
Newton, .					-	1	\$800 00	5.147	35	\$172,716 85
Quincy, .					-			5.224	1	
Revere, .					_			.404		
Somerville,					_	l		.009		
Stoneham,					_	J		19.409	IJ	
Total,	•	•	•		.038	1	<b>\$800 00</b>	36.908	85	<b>\$</b> 172,716 85
Improving 1	ake	Coci	hitua	ute.					-	
Natick, .					_	_	-	2.950	1	<b>\$1,600 00</b>
Total,	•	•	•	•	-	_	-	2.950	1	<b>\$1,600 00</b>
Spot Pond Wa ing of Janu	ter ary	Wor.	ks (1 898)	ak-						
Medford,	•				-	)		.630	) -	A4 A44
Stoneham,		•		. ]	-	} -	-	216.000	} 1	\$1,214,523 63 <sup>1</sup>
Total,						_		216.630	1	\$1,214,528 68

<sup>&</sup>lt;sup>1</sup> Includes \$749.71 paid city of Malden for supplies not part of award.

				Fo	R THE YEAR	1907.	FROM BREINNING OF WORK.				
LOCATI	ON.			Area in Acres.	Number of Settle- ments.	Payments.	Ares in Acres.	Number of Settle- ments.	Payments.		
Spot Pond Impro ings of August June 2, 1902).	v <b>eme</b> : 5, 18	n <b>t</b> (I 99, a	ak. ind								
Medford, .				-	)		41.447	) .			
Stoneham, .				-	} -	-	18.100	} 1	\$25,705 99		
Total, .	•			-	-		54-547	1	\$25,705 99		
Boston Water W ing of January											
Arlington, .				-	h		1.586	h			
Ashland,				-			652.124				
Boston,				-			160.630				
Framingham, .				- •	[]		663.460				
Hopkinton, .				-			654.729				
Marlborough, .				-			30.552	ii			
Medford, .				-			25.140				
Natick,				-			436.228				
Needham, .				-			31.695	.			
Newton,				_	} -	-	78.308	1	\$12,768,948 80		
Sherborn, .				-			40.385				
Somerville, .				_			12.426				
Southborough,				-			17.168	[.]			
Wayland, .				_			177.875				
Wellesley, .				_			189.115				
Westborough,				_			545.912				
Winchester, .				_			76.094				
Woburn,				_			.578				
Total, .					<del>-</del>	_	3,744.000	1	\$12,768,948 80		
Aggregates,				46.24	14	\$10,829 49	16,538.116	881	\$18,257,848 72		

<sup>&</sup>lt;sup>1</sup> Estimated areas.

The settlements above enumerated include all lands acquired for which a complete settlement has been made. About 116.05 acres of the lands acquired and settled for have been subsequently sold and conveyed by the Board.

The tables of settlements for lands acquired do not include: —

1. Lands acquired but not paid or settled for, amounting to about 120.13 acres, including 50.77 acres previously owned by the Com-

<sup>&</sup>lt;sup>2</sup> Includes interest.

monwealth and 66.76 acres of other lands for which no claims will probably be made.

- 2. Lands embraced in the St. John's Catholic Cemetery, comprising 26.39 acres in Clinton and 69.75 acres in Lancaster.
  - 3. Areas of streets.

#### (6) CLAIMS AND SETTLEMENTS FOR LOSS OF BUSINESS.

For injury to business caused by the carrying out of the Metropolitan Water Act in the towns of Boylston and West Boylston and in portions of the towns of Sterling and Clinton, settlements were made during the year in 4 cases, the amount paid being \$756.82.

The number of claims of this class settled since the beginning of the Metropolitan Water Works has been 326, and the total sum paid on account of such claims has been \$153,979.18. All of these claims except 19 have been settled outside of the court.

#### (7) CLAIMS AND SETTLEMENTS FOR LOSS OF EMPLOYMENT.

No claims for loss of employment by residents of West Boylston have been filed during the year. This class of claims seems to be finally disposed of.

The whole number of settlements for such claims effected since the beginning of the operations of the Board has been 477. The total amount paid on account of these claims has been \$85,959.65. All of the claims with the exception of 3 were settled without resort to the courts.

# (8) CLAIMS AND SETTLEMENTS FOR DEPRECIATION OF REAL ESTATE.

Settlements for depreciation in the value of real estate not taken by the Board were effected in 7 cases, 4 on account of lands situated in the town of West Boylston amounting to \$12,735, and 3 on account of lands situated in Boylston amounting to \$610.40, making a total for the year of \$13,345.40. The 3 Boylston cases were settled in court after trial. All the West Boylston cases were settled by agreement out of court.

The total number of claims for depreciation settled up to December 31, 1907, has been 282, and the total amount paid thereunder has been \$278,804.91. All of these claims except 45 were settled out of court.

#### (9) CLAIMS ON ACCOUNT OF DIVERSION OF WATER.

There have been 12 claims settled during the year for damages for the diversion of water, amounting to \$2,360.76, and all were for injuries to meadow lands upon the Nashua River, situated in the towns of Harvard, Lancaster and Bolton. The total sum paid under settlements and judgments arising under claims made on account of the diversion of water, since the beginning of the construction of the Water Works, has been \$1,138,069.67.

The sums enumerated as paid in these and in the preceding cases do not include amounts paid for expert services and court expenses.

#### IV. WATER WORKS - MAINTENANCE.

Dexter Brackett, the Chief Engineer of the Water Works, has had general supervision over the maintenance and operation of all the Water Works of the Metropolitan System. He has been assisted by Elliot R. B. Allardice, Superintendent of the Wachusett Department; by Charles E. Haberstroh, Superintendent in charge of the Sudbury and Cochituate Works and of the portion of the Weston Aqueduct above the Weston Reservoir; by George E. Wilde, Superintendent in charge of the Weston Reservoir and the remainder of the Weston Aqueduct, and of all the reservoirs and pipe lines within the Metropolitan District; and by Arthur E. O'Neil, Superintendent of the several pumping stations.

#### (1) OPERATION OF WORKS.

The maintenance of the Water Works embraces the care and operation of the five water pumping stations, of the Pegan and Clinton sewerage pumping stations, the ten storage reservoirs, the ten distributing reservoirs, the four aqueducts, the various filter-beds, the 84 miles of distributing main pipes, as well as the various pipe yards, gate-houses, siphon and terminal chambers, and other structures connected with the several reservoirs and aqueducts, the dwellings for attendants, and various other buildings used or held for operating purposes. There are in addition the Mystic pumping station and the Mystic Aqueduct, which have not been in active operation during the past year.

#### (2) Storage Reservoirs.

The various storage reservoirs of the Wachusett, Cochituate and Sudbury watersheds have normal capacities amounting to 80,823,000,000 gallons, though a somewhat larger amount of water than the stated capacity is at certain periods actually held by some of them. The various capacities are as follows:—

Cochituate watershed: —				_	-	Gallons.
Lake Cochituate, includ	ling	Dudl	ey Po	ond,		2,242,400,000
Sudbury watershed: —						
Sudbury Reservoir,						7,253,500,000
Framingham Reservoir	No	. 1,				287,500,000
Framingham Reservoir	No	. 2,				529,900,000
Framingham Reservoir	No.	3,				1,180,000,000
Ashland Reservoir, .						1,416,400,000
Hopkinton Reservoir,						1,520,900,000
Whitehall Reservoir,						1;256,900,000
Farm Pond,		•				167,500,000
Wachusett watershed: -						
Wachusett Reservoir,						64,968,000,000
Total,						80,823,000,000

The quantity of water contained in the storage reservoirs on January 1, 1907, was 44,153,200,000 gallons. This quantity was increased during the month of January by about 2,600,000,000 gallons, but subsequently, and until the middle of March, there was a loss in storage to an amount of about 2,000,000,000 gallons. From the latter date there was a constant gain until June 11, amounting to a total of about 9,600,000,000 gallons. Subsequent to the last date, and until September 23, there was a continual loss in the quantity of water stored, amounting in all to a quantity about 1,000,000,000 gallons less than the gain which had been effected. The great rainfalls which afterwards occurred and continued until the end of the year increased the quantity in storage by about 20,000,000,000 gallons, so that the entire amount contained in the various reservoirs on December 31, 1907, was 65,859,500,000 gallons, — the largest quantity ever held in storage.

There has been a large increase in the quantity of water in storage in the Wachusett Reservoir. At the beginning of the year the reservoir contained 31,752,900,000 gallons, and at the end of the year

the quantity was 51,267,000,000 gallons,—a gain in the year of 19,514,100,000 gallons. The elevation of the water at the beginning of the year was 364.57 feet above the Boston City Base, or 30.43 feet below the level of the reservoir if filled to high-water mark. The water rose gradually to an elevation of 372.97 feet, but in the summer there was a considerable lowering of the water. During the last three months of the year there was an almost continuous rise, amounting to 15.40 feet, and on December 31 it had risen to a height 10.69 feet below the high-water level.

Water was almost continuously drawn from the Wachusett Reservoir for the Metropolitan Water District, and it contributed the larger part of the entire supply. The only water otherwise discharged from the reservoir was that which was allowed to flow into the river below the dam in accordance with the requirements for the use of the Lancaster Mills. The quantity thus discharged was 3,884,000 gallons per day.

The marginal lands about the Wachusett Reservoir below the anticipated flow line have been kept mowed and in proper condition, and some repairs have been required where the shore had been washed by the heavier rains. Some changes have been made in the operation of the sluice gates and valves in the gate-chambers of the gate-houses by which the noise and vibration, which had formerly been a serious annoyance, has been almost entirely eliminated.

The water of the Sudbury Reservoir, into which is conveyed all of the supply coming through the Wachusett Aqueduct from the Wachusett Reservoir, was in the earlier months kept at a level a little below the stone crest of the dam, in order to provide storage for the yield of the Sudbury watershed. Later in the year, however, the water was allowed to reach Framingham Reservoir No. 3 by flowing over the crest of the Sudbury Dam. The water is supplied from the Sudbury Reservoir to the Metropolitan District through Framingham Reservoir No. 3, and thence by the Sudbury Aqueduct, and also through the Weston Aqueduct. Framingham Reservoir No. 3, from which the water is taken substantially during the entire year, was kept at a level a little below the crest of the overflow.

By an arrangement made with the Boston & Worcester Street Railway Company, under chapter 530, Acts of the year 1906, the company has been straightening and widening the roadways along. both Framingham Reservoir No. 3 and Framingham Reservoir No. 1. This work has necessitated a little filling of the reservoirs at the points of widening, by which the capacity of Reservoir No. 3 will be reduced by about 3,500,000 gallons. The work has been done by and at the expense of the railway company, but proper precautions have been enforced in order to prevent injury to the property of the Commonwealth and the pollution of the water. The company is also to compensate the Commonwealth for the loss of storage capacity.

Water was drawn from Framingham Reservoir No. 2 for the supply of the Metropolitan District for about five months in the middle of the year, and for a few days later in the season water was drawn from this reservoir to replenish Lake Cochituate. Framingham Reservoir No. 1 water was drawn for short periods in the latter part of the year to replenish Lake Cochituate. was drawn for the supply of the Metropolitan District from the Ashland Reservoir for a period of a little more than two months late in the summer and early in the fall, causing a great decrease in the amount in storage, but this decrease was nearly made up during the latter part of the year. In like manner the Hopkinton Reservoir was drawn upon for the supply of the District, greatly reducing the amount in storage, but the reservoir had been nearly refilled at the end of the year. No water was taken during the year from Whitehall Reservoir. The water of this reservoir has, however, been kept near the high-water mark for use in case of necessity. It has been necessary to make some regulations in relation to boating upon this reservoir, for the purpose of enforcing sanitary regulations. No water has been drawn from Farm Pond during the year for the purpose of water supply.

By an arrangement originally made with the city of Boston, in the year 1885, the Framingham Water Company was permitted to take the waters of Farm Pond and Sudbury River to such an extent as might be needed for water supply for the town of Framingham, the water to be taken by the company directly from the pond or from the Sudbury Aqueduct, as the Boston Water Board should from time to time determine. It was, however, provided that the company should not be required to take the water from the pond during such time as the water should be unfit for domestic use. For this water a compensation was to be paid at certain rates, but

the contract was terminable by either party upon written notice to the other of one year. During the larger part of the time the water has been taken by the Framingham Water Company and by its successor, the town of Framingham, from the filter galleries built alongside the pond; but during a part of the past year the water of the pond has been deemed unfit for the purposes of a domestic supply, and the town of Framingham has taken a portion of its water supply directly from the aqueduct. Inasmuch as the rate of compensation in case the entire or a large part of the supply of the town is taken from the aqueduct is deemed by the Board inadequate, a notice has been given by the Board of its purpose to terminate the present contract, which will accordingly be terminated on February 1, 1908. Terms for a new contract have been under consideration, but no definite action has been taken.

The level of the water in Lake Cochituate was at the beginning of the year nearly 6 feet below high-water mark, but it gradually rose and the lake was kept nearly full from the middle of April until early in July. The lowest point was reached late in September, when it was about 7 feet below high-water mark. Water was drawn from the lake at different periods of the year, amounting to between seven and eight months.

The marginal line of ownership of the Commonwealth about Lake Cochituate is very irregular, and can be recognized only by the presence of the stone bounds. The original stone bounds set by the city of Boston were so small that many of them have been thrown out of position by the frost or pulled up and lost. In order that the location of the property line of the Commonwealth can be accurately determined, a considerable number of these bounds have been reset during the year and many new bounds have been erected. It is proposed to place further new bounds at necessary points during the coming year.

The widening of the road-bed of the Boston & Albany Railroad has necessitated the lengthening of the stone arch culvert, where the road passes over the Beaver Dam Brook arm of Lake Cochituate, and also some filling in the lake at points where the railroad runs along-side the shores. Careful sanitary inspection has been maintained in order to prevent the use of unsuitable materials in the work of filling, and also to prevent the possibility of the pollution of the lake or of its tributaries during the progress of the work.

#### (3) DISTRIBUTING RESERVOIRS.

The distributing reservoirs, so called, situated within the Metropolitan District, are maintained not only for facilitating the distribution of water, but also to afford additional protection in case of emergencies. The capacities of these reservoirs are as follows:—

•						Capacity in Gallons.
Spot Pond,						1,791,700,000
Chestnut Hill Reservoir,						300,000,000
Weston Reservoir, .						200,000,000
Fells Reservoir,						41,400,000
Mystic Reservoir, .					•	26,200,000
Waban Hill Reservoir,		٠.				13,500,000
Forbes Hill Reservoir,		`.				5,100,000
Bear Hill Reservoir, .						2,450,000
Arlington Standpipe, .						550,000
Forbes Hill Standpipe,	•	•		•	•	330,000
Total,						2,381,230,000

All of these reservoirs have been kept in good condition, and they have called for but little except the ordinary repairs and the work which has been required for the destruction of the gypsy and browntail moths. More than the usual care and policing are required, especially for the Chestnut Hill Reservoir, Mystic Reservoir, Spot Pond and Forbes Hill standpipe, on account of the large number of visitors who frequent the grounds, particularly on Sundays and holidays.

#### (4) AQUEDUCTS.

The total amount of water carried through the different aqueducts to the Metropolitan District was a daily average of 126,403,000 gallons. There was drawn from the Wachusett Reservoir through the Wachusett Aqueduct into the Sudbury Reservoir an average of 82,589,000 gallons per day. An average of 84,655,000 gallons per day was carried from Framingham Reservoirs Nos. 2 and 3 through the Sudbury Aqueduct to the Chestnut Hill Reservoir, and an average of 11,398,000 gallons per day from Lake Cochituate through the Cochituate Aqueduct to the same reservoir. Through the Weston Aqueduct an average of 30,350,000 gallons per day was drawn from the Sudbury Reservoir into the distribution system of the

District. The Spot Pond watershed is estimated to have furnished in addition 418,000 gallons per day.

The Wachusett Aqueduct was in active operation on 333 days during the year. Considerable wire fencing has been erected along the line of the aqueduct, to prevent cattle from trespassing upon the embankments. Brush and weeds have been removed, and the fruit trees especially have been cut and carried away.

The Sudbury Aqueduct was in operation on 357 days of the year for conveying water to the Chestnut Hill Reservoir, and on 7 days water was conveyed through the aqueduct from Framingham reservoirs Nos. 1 and 2 to Lake Cochituate.

The Cochituate Aqueduct was in use 216 days of the year. The flow through the aqueduct was suspended for several weeks on account of the laying, by the city of Newton, of a pipe sewer and underdrain beneath the aqueduct. Considerable work was done along the line of the aqueduct in setting property bounds.

Water was drawn through the Weston Aqueduct for a period of 359 days. It was deemed necessary during the year to erect a barn on land of the Commonwealth along the aqueduct for the use of the foreman in charge of the line.

## (5) Pumping Stations.

The water which is supplied to the Metropolitan District is substantially all received from the Cochituate and Sudbury aqueducts at or near the Chestnut Hill Reservoir and thence pumped into the distribution system, or is conveyed through the Weston Aqueduct and distributed through the system by gravity. Seventy-five per cent. of the water thus supplied was received and pumped at the two stations at Chestnut Hill Reservoir. The water is pumped from the Chestnut Hill high-service station to the higher districts of Boston, and to Quincy, Watertown, Belmont and a part of Milton. From the Chestnut Hill low-service station the water is pumped to the lower districts of Boston, including Boston proper, South Boston and portions of Roxbury and Dorchester, to Somerville, Chelsea, Malden, Medford, Everett and Arlington, and also to Spot Pond. Water is pumped a second time from Spot Pond to Melrose, Revere, Winthrop, Nahant, Swampscott, and the higher portions of Somerville, Chelsea, Malden, Medford and Everett. From the Arlington pumping station the water is pumped a second time to Lexington and the

higher portions of Arlington, and from the West Roxbury station to the higher portions of West Roxbury and Milton.

The quantity of water pumped at all of these stations during the year was 38,213,520,000 gallons, which was an increase of 8.6 per cent. over the quantity pumped during the preceding year. The cost of operating all the stations during the year was \$112,248.67, or \$2.937 per million gallons pumped, — a cost of \$0.027 per million gallons over the cost of the preceding year. There was a considerable increase in the cost of labor, owing in part to the decrease in the hours of labor of pumping station employés, and in part to the increase in the rates of wages paid to the employés. There was generally a slight decrease in the cost of fuel used at the stations, so that the result has been that the average cost at all the stations of raising one million gallons of water one foot high has been the same as during the preceding year, or \$0.0329.

During the year 12,126.87 tons of coal were purchased for use at the various stations. Of this total, 7,200.17 tons were bituminous, 350.53 tons anthracite, 3,961.58 tons buckwheat anthracite, and 614.59 tons were anthracite screenings. The average price per gross ton for the bituminous coal varied at the different stations from \$3.99 to \$4.84. The cost of the anthracite used was \$7.28 per gross ton, of the buckwheat anthracite \$2.87, \$2.97 and \$3.01, and of the anthracite screenings \$2.24.

Tests have been continued in order to determine the heating value of the coal used and offered for use in the several stations, and also to determine the viscosity, specific gravity and burning point of the oil used.

The cost per million gallons of water raised one foot was: for the Chestnut Hill high-service station, \$0.028; for the Chestnut Hill low-service station, \$0.031; for the Spot Pond station, \$0.034; for the Arlington station, \$0.127; for the West Roxbury station, \$0.210.

At the Chestnut Hill high-service station not only has a new boiler been installed, but the foundations of the old boilers have been renewed and considerable repairs have been required on another of the boilers. An accident occurred also to one of the smaller pumping engines, which made necessary a new cylinder and piston. These repairs increased somewhat the operating cost of the station.

By reason of the delay in the completion of the new Arlington pumping station and of the installation of the machinery, the old engines in the temporary station were kept in service nearly the entire year, the first of the new engines having been put into regular service in the month of December. On account of the necessity of maintaining both the old and new stations for a considerable portion of the year, the cost of operation of this station has been larger than during the preceding year.

Owing to the discovery and stopping of leaks in the West Roxbury mains, the quantity of water pumped during the year at the West Roxbury station has been less than during the previous year. No extensive repairs have been called for at this station, but the pumps will soon reach their limit of safety, it being necessary now at times to operate both of them to their full capacity.

#### (6) PIPE LINES.

No break has occurred in the pipes during the past year. Thirty leaks have been found and repaired upon the pipe lines. All but three of these leaks occurred in joints of the pipes. Fourteen of them were found upon the pipe lines which cross the Charles and Mystic rivers, where the changes of temperature especially affect the pipes. The cost of repairing the leaks in the river pipes is considerable, as the employment of a diver and dredge is necessary.

A new Venturi meter has been placed in the force main leading from the new Arlington pumping station, and it has been necessary to enlarge the Venturi meter measuring the water supplied to the West Roxbury district, on account of the increased consumption. At several points it has been necessary to take measures to protect the registers from freezing. Valves have been continued in use for reducing and regulating the pressure of water supplied in the remoter districts. Considerable general repairs have been required during the year.

# (7) SEWERAGE AND FILTRATION WORKS.

# (a) Clinton Sewerage Works.

There was a large increase in the quantity of sewage received at the Clinton pumping station from the Clinton sewers, the total increase over the preceding year amounting to between 8 and 9 per cent. This increase was largely, however, due to the leakage of ground water into the sewers during the three months when the rainfall was unusually great, the daily average quantity of sewage received during these months being double the amount received during the dry months of the year.

Experiments have been continued at the filter-beds under the direction of the Chief Engineer of the State Board of Health, and also further changes have been made in the practical treatment of the sewage, for the purpose of increasing the efficiency of the filtration. The 8 settling basins have been put into use during the greater part of the year for much shorter periods of time, and the filter-beds also, which number 25, are made to receive the sewage much more frequently and for a very short period at a time, so that each filter-bed has in general been in use a part of every day. The changes which have been made in the method of applying the sewage have thus far slightly improved the character of the effluent, and it is anticipated that a greater efficiency will be attained under the system which has been put into use and as a result of the experiments which are in progress.

The total cost of pumping was \$4,579.76, which is largely in excess of the cost of last year. This increase is due not only to the larger quantity of sewage pumped, but also to the necessity which came for unusually large repairs, and especially to the increase in the rate of wages in connection with the lessened number of hours of labor. The cost per million gallons pumped was \$4.47, and the cost per million gallons of sewage raised one foot was \$0.28. There was a corresponding but not so great an increase in the cost of maintenance of the filter-beds, which amounted to \$3,055.18, — a cost per million gallons treated of \$9.77.

The farmers in the neighborhood are becoming each year more desirous of obtaining the sludge removed from the settling basins, which is furnished them free for use on their farms.

# (b) Marlborough Filter-beds.

The Marlborough filter-beds, built to filter the waters of a brook running through a part of the city of Marlborough which at times also receives the washings from the streets, have been sufficient for the proper filtration of all the waters without any direct discharge into the Sudbury Reservoir. There has been but little overflow during the year from the Marlborough sewers into the small filtration basin constructed to receive the sewage in case the city system should be inadequate to dispose of all the contents of the sewers.

#### (c) Pegan Filtration Works.

The Pegan Brook filter-beds, which are situated in Natick at Lake Cochituate, were in operation on 228 days during the year. A total quantity of 266,000,000 gallons was received from the Pegan Brook, and 98,859,000 gallons from the intercepting ditch which, built around the shores of Lake Cochituate, collects the water from the brooks which formerly entered into the Pegan Brook Meadow.

The cost of operating the pumping station and maintenance of the filter-beds, grounds and ditches was \$2,841.14, a cost per million gallons pumped of \$9.29. This was a material decrease in the cost of the operation of these works, owing to the fact that the thorough cleaning occasionally required was not done in the past year.

The widening of the road-bed of the Boston & Albany Railroad has decreased somewhat the capacity of one of the filter-beds.

#### (8) SANITARY INSPECTION AND WORK.

William W. Locke, C.E., has been in immediate charge of the sanitary inspection of all of the watersheds, and has been aided by two regular assistants and by such laborers and others as have been required from time to time.

No epidemic has occurred during the year on any of the watersheds. There were 6 sporadic cases of typhoid fever upon the Wachusett watershed, and 30 such cases upon the Sudbury and Cochituate watersheds, a total of 36 cases, as compared with 55 cases in the preceding year. In 18 of these cases the patients resided in houses connected with public sewers which discharge the sewage outside of the watershed, and none of the whole number of cases occurred upon lands belonging to the Commonwealth. In all the cases, however, proper precautions were at once taken to prevent a possible pollution of the water supply, and no ill effects have resulted so far as known.

Inspection during the year upon the Wachusett watershed was made of 1,461 private premises, for the purpose of ascertaining whether there were any conditions needing correction or improvement, particularly with reference to cesspools, privy and sink drainage, manure piles and manufacturing wastes. Of these, 1,323 were

declared to be satisfactory at the end of the year, and 138 cases were pronounced "unsatisfactory," this term including all cases where there may be under the most unfavorable conditions wash from privies or direct sink drainage, all suspected cases, and all cases of manufacturing wastes entering brooks or feeders to the reservoir notwithstanding such attempts as may have been made to purify them. Remedies for defects which were found were effected in 42 cases, 5 of which were remedied by the construction of filter-beds. Partial remedy was effected in 8 cases.

On the Sudbury and Cochituate watersheds 7,527 premises were inspected, and of these, 7,197 were pronounced satisfactory at the end of the year and 330 unsatisfactory. In 163 cases remedies were effected by sewer connections, and 11 other cases were otherwise remedied. Partial remedy was effected in 25 cases. Considerable attention has been devoted to preventing the pollution of the water supply by the different gangs of men employed in the building of State highways in Boylston, West Boylston and Holden, in the widening of the Boston & Worcester Street Railway in Framingham, in widening the road-bed of the Boston & Albany Railroad in Natick, and in laying of water pipes for the Westborough Insane Hospital in Crane Swamp in Westborough.

Water is collected at weekly intervals from the various storage and distributing reservoirs and as often as monthly from the various main feeders of the water system, and sent to the laboratory of the Board for examination microscopically and for color, odor, taste and turbidity. Samples of water are also collected at monthly and semimonthly periods from different points upon the works, and sent to the State Board of Health for chemical analysis. In the biological laboratory of the Board 2,624 microscopical, 1,212 biological and 24 chemical examinations have been made. The bacteriological work consisted of examinations of the main feeders of the Sudbury Reservoir, of Framingham Reservoir No. 3 and of Lake Cochituate, and also testing the efficiency of the Pegan Brook, Marlborough Brook and Sterling filter-beds.

The sanitary condition of the Wachusett watershed has been much improved during the year by the construction of the Sterling filterbeds, and also by the construction of the small filter-beds near the Sterling Camp Grounds. There have also been destroyed 10 addi-

tional buildings upon property belonging to the Commonwealth, and the premises formerly occupied by these buildings, particularly the sites of the old Dorr and Warfield mills in Holden, and of the Gates farm buildings on Lake Waushacum, have been cleaned up and put in proper sanitary condition.

On the Cochituate and Sudbury watersheds railroad companies whose tracks cross the Framingham reservoirs have, at the request of the Board, caused tight floors to be laid over the bridges, for the purpose of preventing any direct pollution of the water from the passing trains.

The drainage ditches which have been constructed in swamps on the different watersheds, aggregating a length of 31.66 miles, have been cleaned, and the weeds and brush on the sides have been mowed and burned. Some of the ditches on the Sudbury watershed have required repaying where the slopes have been trampled by cattle.

Snake Brook, which flows into Lake Cochituate, has been improved for a distance of about 1,900 feet by removing the weeds and shrubs and by the gravelling and paving of the bottom and sides, and for a considerable distance a new and more direct channel has been constructed. Portions of land which approached too closely the brook have been acquired, and considerable wire fencing has been done to protect the land belonging to the Commonwealth from the cattle in the abutting pastures.

Considerable improvement has also been effected in the condition of Beaver Dam Brook, which, running through portions of the towns of Framingham and Natick, is one of the principal feeders of Lake Cochituate. For about two miles before entering the lake the stream is sluggish, and large quantities of mud, as well as débris of all kinds, thrown or falling into the water, have collected in the various pools. Much of the objectionable matter has been removed, and the heavy growth of shrubbery bordering the brook has been largely cut and destroyed. A survey and examination of the lower part of the brook have also been made, with a view to more extensive improvement of the conditions in the future.

The Board has continued the policy of restricting and regulating boating and fishing upon Lake Cochituate, for the purpose of protecting the water of the lake from further pollution. No boating or fishing has been allowed upon the section of the lake lying north of Lake Avenue, from which the water is delivered directly into the Cochituate Aqueduct.



IMPROVEMENT OF SNAKE BROOK NEAR LAKE COCHITUATE.





Boating and fishing have been permitted in the remaining portions of the lake during the season beginning with April 1 and ending on October 15, in boats registered in accordance with the regulations which have been made and by persons who have been duly licensed by the Board. Permission has been given to the public to fish from the highway during the season named, and at other seasons to fish through the ice in other than the prohibited portion of the lake.

Applications for registration of boats were received to the number of 176, and 142 of these were granted, 3 of them with privilege of using tenders also for various sail and motor boats. Of those whose applications were granted, 114 were residents of Natick in the vicinity of the lake; 6 were residents of the village of Cochituate, the adjoining portion of the town of Wayland; and 22 were owners or lessees of cottages built upon land immediately abutting the shore margins. Of the 34 applications which were rejected, 10 were made subsequent to the time limited for filing the applications; 7 were from residents of towns not bordering upon the lake; 5 were from those who had become owners or lessees of cottages subsequent to March 1, 1906; 2 were from applicants who had in the previous year violated the regulations; 3 were in cases where registration had been already granted to members of the family; and 7 were for the use of tenders for which arrangements were otherwise made. No other registration was refused to residents of the territory immediately surrounding the lake or to those who had been owners or lessees of surrounding cottages prior to March 1, 1906.

Stringent measures were enforced for keeping the premises abutting the shore margins in good sanitary condition, and for preventing the pollution of the water by the cottagers and campers.

The owners and lessees of registered boats have shown a helpful cooperation with the Board by the satisfactory observance of the regulations which have been adopted for the protection of the water supply. No violation of the regulations was reported for prosecution.

An appeal which had been taken to the Supreme Court upon an injunction which had been granted against an owner of one of the cottages who had persisted in violating the rules of the Board was overruled by the full bench of the court.

#### (9) Forestry.

The operations carried on in past years about the Wachusett Reservoir in the way of clearing the margin and replacing and planting the trees has been hitherto in part classed under construction. All the work is now done under the head of maintenance.

The clearing of a strip, along the extreme margin of the territory owned by the Commonwealth, through the wooded and shrub land, has been extended during the past year for a length of about 2 miles, so that now a cleared margin about 40 feet wide, called the fire guard, is around the entire limits of the Commonwealth's property. A strip about 15 feet wide has also been cleared on each side of brooks through wooded lands to the length of about 5,700 feet.

Mature and otherwise undesirable trees have been cut down in other places, and considerable areas have been improved by the thinning out of the trees. A large area which had been previously planted with white pines, upon which has come up a heavy growth of birches, alders and briers, has been cleared by the cutting out of the trees and brush which would interfere with the growth of the pines. The timber obtained by these processes has amounted to about 15,000 feet, board measure, and in addition more than 450 cords of firewood have been obtained. The most of the timber and firewood has been sold.

The greater part of the cleared margin of the reservoir had been previously planted, principally with arbor vitæ, and there remains about 1½ miles in length still to be treated. Inasmuch, however, as many of these trees had failed, it was determined to postpone the further planting until a stock of larger trees could be obtained from the nurseries. An area of about 20 acres has been planted with white pine seedlings, and the locusts upon the Oakdale flats, which had died, have been replaced. The total marginal land around the reservoir belonging to the Commonwealth is now estimated to comprise 3,412 acres. Of this aggregate, 1,483 acres were more or less wooded when acquired. There have been planted with trees 1,117 acres, and there are 315 acres which it is proposed to plant in the future. The marginal strip immediately along the shores of the reservoir contains 197 acres, and there are 300 acres which it is not proposed to plant with trees.

The Flagg and the Lamson nurseries, so called, situated respectively on the south and north sides of the reservoir, have been maintained. At the Flagg nursery a great number of white pines and arbor vitæ have been removed from the nursery beds to the transplant rows. The nursery now contains in the transplant rows 363,540 white pines, 28,300 arbor vitæ, 4,380 Scotch pines and 3,140 white spruces. Many arbor vitæ seedlings have also been transferred from this nursery to the Lamson nursery, where the soil is better adapted for their growth. The Lamson nursery contains in transplant rows 154,200 arbor vitæ, 13,580 sugar maples, 8,810 locusts, 3,090 white oaks, 3,000 ashes, 2,300 walnuts, 700 Norway spruces and 54 catalpas.

About the Sudbury Reservoir and around Framingham reservoirs Nos. 2 and 3 many worthless apple trees have been cut down, and, so far as marketable, sold for firewood; and a large quantity of brush has also been collected and burned. White pine trees to the number of 3,200 have been planted during the year at the Sudbury Reservoir.

#### (10) MOTH SUPPRESSION.

The extensive work which has been carried on by the Board in previous years on the lands under its charge, not only at Spot Pond but in the cities of Medford and Somerville and the town of Arlington, has resulted in greatly reducing the number of gypsy moths, and it is believed that the work of the past year will be felt by a still further reduction in their number in the future.

There has, however, during the year been a considerable increase in the number of gypsy moths along the lines of the Sudbury and Cochituate aqueducts in Newton, Weston, Natick and Framingham. The 220 acres of land about the Weston Reservoir and lying along the Weston Aqueduct between the reservoir and the terminal chamber were especially infested, and the cost of protecting these lands was more than double the amount expended in the previous year. No gypsy moths have been found upon the property of the Board situate west of the town of Framingham.

The number of brown-tail moths at the Chestnut Hill Reservoir and on other lands in the vicinity of Boston has been greatly decreased, apparently from natural causes. Very large numbers of nests of the brown-tail moths have been destroyed at the Sudbury Reservoir, and these nests in considerable and increasing numbers have been de-

stroyed at the Hopkinton Reservoir, along the line of the Wachusett Aqueduct in Southborough and Northborough, and in the vicinity of the Wachusett Reservoir in Clinton.

The methods employed for destroying and for preventing the spreading of the moths were similar to those of preceding years. The egg clusters of the gypsy moths were painted during the winter season with a mixture of creosote and fuel oil, in the spring tangle-foot was used in large quantities for banding the trees, and in the summer many trees were sprayed with arsenate of lead. In order to protect the lands of the Commonwealth along the lines of adjoining properties where moths were prevalent, lines of boards were set on edge and smeared with tanglefoot.

It has been found necessary, where there were thick growths of underbrush, particularly along the lines of the aqueducts, to cut away the underbrush and also the undesirable trees.

The total amount expended for the purpose on the Water Works lands was \$10,700, being \$2,000 less than the expenditure of the previous year. Of the total amount expended, \$6,450 was devoted to lands about Spot Pond and \$1,300 to those about the Weston Reservoir.

## (11) QUALITY OF THE WATER.

The quality of the water supplied to the Metropolitan District has been good throughout the year, and has somewhat improved in quality over the preceding year. The color has remained substantially the same, but the microscopic organisms have decreased in number. Especial improvement has been observed in the quality of the water of the Wachusett Reservoir, as well as of the Sudbury Reservoir and Framingham Reservoir No. 3. There have been few growths of objectionable taste or odor. The number of organisms found in Lake Cochituate is larger than that in any other source of regular supply, and for about one-third of the year the number was such as to make the water objectionable for use, although not injurious to the public health. But little trouble has been experienced in the water coming from other sources.

# (12) THE WATER SUPPLY.

For the fourth consecutive year the rainfall on the Sudbury and Wachusett watersheds and the amount of water yielded have both been below the average for the years during which records have been kept. The rainfall during the past year on the Sudbury watershed was 44.38 inches, or 1.61 inches below the average. On the Wachusett watershed the total rainfall was 45.74 inches, or 3.25 inches below the average. On both of the watersheds the yield during the early part of the year was far below the average, and was the lowest or nearly the lowest recorded. During the last four months of the year, however, the rainfall and yield were unusually large, so that the yield for the entire year of both the Sudbury and Wachusett watersheds was but little below the average.

All the cities and towns constituting the Metropolitan Water District have been supplied with water, except the city of Newton and the town of Hyde Park, whose sources of supply are still adequate for their purposes. Water was furnished by special agreement to the town of Swampscott, which is without the limits of the District; and to a small part of the town of Saugus, which is directly supplied by special arrangement by the town of Revere; and 50,000 gallons daily were supplied to the United States Government reservation on Peddock's Island, in accordance with arrangements made with the Government.

The total quantity of water supplied by the Metropolitan Water Works to the various cities and towns, including the small quantity yielded by the Spot Pond watershed, as determined at the pumping stations and by the flow through the Weston Aqueduct, was 45,650,960,000 gallons. The average quantity daily supplied was 125,071,000 gallons, which is an increase in the daily supply of 6,251,000 gallons.

The increase in population of the territory supplied with water over that of last year is estimated at 19,690, the estimated population as of July 1, 1907, being 933,400.

The daily average quantity of water measured by the Venturi meters as delivered to the various municipalities is, owing to leakage from reservoirs and pipe lines, as well as in a small degree to the use of water at the pumping stations, 885,900 gallons less than the daily average amount above given.

The city of Newton and the town of Hyde Park supplied from their own sources to their respective inhabitants a total of 1,273,639,347 gallons, being a daily average of 65.5 gallons per inhabitant.

#### V. WATER WORKS — FINANCIAL STATEMENT.

By chapter 235 of the Acts of the year 1906, the Board was required on or before the third Wednesday in January of each year to report to the General Court an abstract of its receipts, expenditures, disbursements, assets and liabilities for the previous fiscal year (which, by the provisions of chapter 211 of the Acts of the year 1905, is the year beginning with the first day of December and ending with the thirtieth day of November), together with all recommendations for legislation which it should deem desirable; and the Board was also required by the Act of 1906 to present in the month of February a more detailed statement of its doings for the calendar year next preceding, which detailed statement should be printed as its annual report for the year.

The financial abstract for the fiscal year ending with the thirtieth day of November, 1907, was accordingly presented to the General Court in January, and a copy of this financial abstract is in part printed as Appendix No. 5.

The following statement of its financial doings, in relation to the Metropolitan Water Works, for the calendar year 1907, is herewith presented, in accordance with the provisions of the Act of 1906, as a part of the annual report of the Board.

The Metropolitan Water Loans authorized for the construction and acquisition of works have amounted to \$40,500,000. To this sum are added the proceeds from the sale of certain property by the Board, and these amounted on January 1, 1908, to \$158,408.11. The total amount, therefore, which the Board has been authorized to expend is \$40,658,408.11. The amount of expenditures approved by the Board for payment out of the Metropolitan Water Loan Fund was, for the year 1907, \$188,631.02, and the total amount so approved for payment since the beginning of the work up to January 1, 1908, has been \$40,467,508.04. There was accordingly a balance remaining at the beginning of the year 1908 amounting to \$190,900.07.

The Treasurer of the Commonwealth has issued from time to time, on the request of the Board, bonds to the amount of \$40,500,000. These bonds were issued for terms of 39½ and 40 years from the

date of issue, and bear interest at the rate of 3 per cent. and 3½ per cent. per annum. The sinking fund established for the payment of the bonds at maturity amounted on January 1, 1908, to \$5,643,-575.69.

The amount approved by the Board for the maintenance and operation of the Water Works for the year 1907, which was paid out of the annual assessments, was \$373,334.07.

The assessments for the year 1907, for the payment of interest on the bonds, for the sinking fund requirements, and for the expenses of operation and maintenance of the Water Works, which were levied upon the various cities and towns in the Metropolitan District, amounted to \$2,195,406.71.

The detailed financial statement regarding the Metropolitan Water Works is as follows:—

#### (1) METROPOLITAN WATER LOANS, RECEIPTS AND PAYMENTS.

The loans for the construction and acquisition of the Metropolitan Water Works, the receipts which are added to the proceeds of these loans, the expenditures for the construction and acquisition of works, and the balance available on January 1, 1908, have been as follows:—

Loan under chapter 488 of the Acts of 1895,						\$27,000,000	00
Loan under chapter 453 of the Acts of 1901,						13,000,000	00
Loan under chapter 367 of the Acts of 1906,	•	•		•	•	500 000	00
						\$40,500,000	00
Proceeds from the sales of property applica and acquisition of works (of which \$10,0							
1907),		•	•		•	158,408	11
						<b>\$40,658,4</b> 08	11
Amount approved by the Metropolitan Wate for payments to December 31, 1907 (of wh			- 0				
the year 1907)		•		•		40,467,508	<b>04</b>
Balance January 1, 1908,						<b>\$190,90</b> 0	07

## (2) Issues of Metropolitan Water Loan Bonds.

The Treasurer of the Commonwealth, under the authority given him to issue from time to time, on the request of the Board, negotiable bonds to an amount not exceeding \$40,500,000, to be designated the "Metropolitan Water Loan," has sold bonds as follows:—

DATE	o <b>r</b> 8	ALE.			Amount of Bonds sold.	Rate of Interest (Per Cent.).	Price received.	Date due.	Premium.
Sept. 25, 1895, . Nov. 23, 1896, . Feb. 8, 1897, . Jan. 13, 1898, . Jan. 13, 1898, . June 15, 1899, . June 28, 1900, . Mar. 5, 1901, . July 24, 1901, . July 24, 1901, . July 30, 1901, . Aug. 7, 1901, . Aug. 8, 1901, . Aug. 8, 1901, . Sept. 17, 1901, . Oct. 1, 1901, . Oct. 1, 1901, . Oct. 24, 1901, . Feb. 26, 1902, . Feb. 26, 1902, . Feb. 26, 1902, . April 7, 1903, . Jan. 15, 1904, . Jan. 15, 1904, . Mar. 24, 1905, . June 28, 1906, .			:		\$5,000,000 2,000,000 2,000,000 2,000,000 3,000,000 1,000,000 130,000 200,000 300,000 130,000 200,000 1,000,000 1,250,000 50,000 1,250,000 500,000 200,000 1,250,000 1,250,000 250,000 1,250,000 250,000 1,250,000 1,250,000 250,000 1,250,000 1,250,000 1,250,000 300,000 300,000 300,000 403,000 403,000 403,000 403,000 403,000 403,000 403,000	31/4 31/4 31/4 31/4 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	110.67 106.76268 107.82 113.176 112.877 100.64 102.155 100.375 100.10 100.25 100.25 100.25 100.25 100.10 100.25 100.10 106.71 100.10 106.725 106.71 106.725 106.725 106.725 106.725 106.725 106.761	July 1, 1935, July 1, 1935, July 1, 1935, Jan. 1, 1938, Jan. 1, 1938, July 1, 1839, July 1, 1839, July 1, 1839, Jan. 1, 1941, Jan. 1, 1944, Jan. 1, 1943, Jan. 1, 1943, Jan. 1, 1944, Jan. 1, 1944,	185,253 60 469,200 00 283,520 00 283,520 00 19,200 00 27,800 00 64,650 00 512 50 125 00 250 00 300 00 208,010 00 273,900 00 16,812 50 76,661 25 23,000 00 37,446 50 29,138 70
June 28, 1906, . June 28, 1906, .	:	:	:	:	100,000 307,000	31/2 31/2	103.09 <sup>2</sup> 103.09 <sup>2</sup>	Jan. 1, 1946, Jan. 1, 1946,	3,090 00 9,486 30
					\$40,500,000	,-		, , , , , ,	\$2,588,071 35

<sup>1</sup> Including \$18,678.60 from readjustment of rate made by the Treasurer in 1897.

## (3) METROPOLITAN WATER LOAN SINKING FUND.

The sinking fund established by the Treasurer of the Commonwealth has amounted at the end of each year to sums as follows:—

December 31, 1895,					<b>\$226,286</b> 05
December 31, 1896,					699,860 70
December 31, 1897,					954,469 00
December 31, 1898,					1,416,374 29
December 31, 1899,					1,349,332 97
December 31, 1900,					1.573,619 72
December 31, 1901,					1,662,426 95
December 31, 1902,					2,256,803 81
December 31, 1903,					2,877,835 59
December 31, 1904,					3,519,602 92
December 31, 1905,			٠.		4 207,045 69
December 31. 1906,	•				4,897,822 62
December 31, 1907,					5,643,575 69

# (4) Annual Assessments and Receipts.

Assessments for the year, amounting to \$2,195,406.71, were required for the payment of the interest on the bonds issued by the Commonwealth, the sinking fund requirements, and the expenses of

<sup>&</sup>lt;sup>2</sup> Not issued or delivered until 1907.

operation and maintenance of the Water Works. The requirements were: for interest, \$1,281,908.77; for the sinking fund, \$523,697.26; and for maintenance and operation, \$389,800.68. These assessments were made by the Treasurer of the Commonwealth upon the various municipalities as follows:—

Arlington,			\$14,738 41	Nahant, .			<b>\$4,204</b> 56
Belmont, .			6,026 81	Newton, .			6,026 82
Boston, .			1,726,588 68	Quincy, .			50,027 14
Chelsea, .			58,058 80	Revere, .			19,633 70
Everett, .			41,044 26	Somerville,	•		106,334 61
Hyde Park,			1,194 73	Stoneham,			7,734 91
Lexington,			6,987 53	Watertown,			15,468 18
Malden, .			40,082 71	Winthrop,		•	14,624 69
Medford, .			35,126 98				
Melrose, .			26,971 19			8	2,195,406 71
Milton, .	•		14,532 00				

The comparatively smaller sums assessed upon the city of Newton and the town of Hyde Park were owing to the fact that neither of these municipalities had reached the safe capacity of its own sources of water supply, and neither had been furnished with water.

The proceeds from the operations of the Board, exclusive of the proceeds from sales of property and of water, are, in accordance with the provisions of the Statutes, applied to the reduction of the assessment, and these, for the year 1907, amounted to \$7,148.55.

The actual expenditures for the maintenance and operation of the Metropolitan Water Works were, for the year 1907, \$373,334.07.

# (5) SUPPLYING WATER TO CITIES AND TOWNS OUTSIDE OF DISTRICT AND TO WATER COMPANIES.

Sums have been received during the year 1907, under the provisions of the Metropolitan Water Act, for water furnished, as follows:—

Town of Framingham, .					\$147 67
Town of Swampscott					4,800 00
Framingham Water Company	7,			<b>'.</b>	666 35
United States Government,					1,321 40

\$6,935 42

(6) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works:—

Construction and Acquisition of Works.		ear ending or 31, 1907.	From Beginn to Decembe	
Administration applicable to all parts of the				
construction and acquisition of the works	,	<b>\$6,36</b> 6 96		<b>\$268,968 4</b> 2
Wachusett Dam and Reservoir:—				
Wachusett Dam,	1		\$2,285,999 20	
Power plant,	1	•	118 00	
North Dike,			790,470 68	
South Dike			187,057 10	
Removal of soil,	1 -,		2,536,214 37	
Relocation of railroads,	1,026 51		878,022 45	
Roads and bridges,	2,036 07		547,180 83	
Real estate,	16,890 16		3,195,950 78	
Damages, real estate not taken, business	1			
and loss of wages,	14,102 22		518,743 74	
Other expenses,	1,532 50	99,592 85	8,272 92	10,897,129 52
Improving Wachusett watershed		19,870 72		207,406 53
Wachusett Aqueduct,		252 05		1,797,946 85
Sudbury Reservoir,		202 00		2,922,445 21
Protection of Sudbury supply,		_		129,190 86
improving Sudbury watershed		99 45		95,484 54
Protection of Cochituate supply,		-		9,000 00
Improving Cochituate watershed,		_		8,860 68
Improving Lake Cochituate,		_		103,537 29
Pipe lines, Dam No. 3 to Dam No. 1,		_		48,471 48
Pipe line, Rosemary siphon,		_		23,142 96
Weston Aqueduct:—				20,112 00
Aqueduct,	\$48 34		\$2,352,184 66	
Reservoir,	1		288,838 06	
Supply pipe lines,	100 10		584,689 71	•
Real estate, taxes and other expenses,	8,157 09		207,648 12	
• •		8,859 13		8,433,805 5
Distribution system:—				
Low service: -				
Pipe lines and connections,	\$1,247 02		\$1,752,873 08	
Pumping station, Chestnut Hill,	-		462,572 19	
Reservoir, Spot Pond,	4,087 15		582,188 73	
Gate house and connections, Chestnut				
Hill Reservoir,	-		65,480 88	
Real estate and other expenses,	811 40		91,722 06	
Northern high service:—			•	
Pipe lines and connections,	1 50		440,540 78	
Spot Pond pumping station,	-		291,829 35	
Fells Reservoir, Stoneham,	-		141,392 94	
Bear Hill Reservoir, Stoneham,	-		38,267 70	
Real estate and other expenses,			14,838 05	
Amounts carried forward,	\$6,147 07	\$129,040 66	\$3,881,705 76	@10 044 8NO 4

Construction and Acquisition of Works.		ear ending r 31, 1907.		From Beginning of Work to December 31, 1907.			
Amounts brought forward,	\$6,147 07	\$129,040 66	<b>\$3,881,705</b> 76	\$19,944,889 4			
Distribution system — Concluded.							
Southern high service: —							
· Pipe lines and connections,	234 75		515,132 30				
Pumping station, Chestnut Hill,	4,703 44		246,928 96				
Forbes Hill Reservoir, Quincy,	-		90,008 49				
Waban Hill Reservoir, Newton,	-		61,592 11				
Real estate and other expenses,	-		10,226 36				
Northern extra high service,	42,785 27		72,029 13				
Southern extra high service,	-		22,830 67				
Meters and connections,	78 42		77,038 33				
Improving Spot Pond Brook,	-		8,991 23				
Glenwood pipe yard,	-		88,100 59				
Chestnut Hill pipe yard,		53,943 95	11,311 26	5,025,890 1			
Diversion of water, South Branch of Nashua		00,020 00		0,020,000 1			
River,1		8,891 30		1,363,631 7			
Acquisition of existing water works: —			1				
Reimbursement city of Boston, partially			1				
constructed Sudbury Reservoir,	-		\$1,157,921 59				
To Boston, for works taken January 1,							
1898,	-		12,768,948 80				
To Malden, Medford and Melrose for							
taking of Spot Pond,	-		1,240,229 62				
To Newton, for Waban Hill Reservoir, .	-		60,000 vo				
Transfers of works acquired and other			\$15,227,100 01				
property to accounts for special works,	-		1,240,262 50				
			<b>\$13,986,837</b> 51				
Washanding convergencing etc			73,126 22				
Engineering, conveyancing, etc.,			15,120 22	14,059,968 7			
Pipes, Valves, Castings, etc., sent first to			i				
Storage Yards, and afterwards transferred							
as needed to Different Parts of the Work.			ł				
Sent to storage yards,	<b>\$4,021 86</b>		\$2,092,396 06				
Transferred from storage yards to works,			l				
and included in costs above	1,766 25	0.055.11	2,019,263 11	70 100 O			
Total for constructing and acquiring of		2,255 11		73,132 9			
works,		\$188,631 02		<b>\$40,467,508</b> 0			

 $<sup>^{1}</sup>$  Of the total expenditures from the beginning of the work, the sum of \$150,928.29 is for Clinton sewerage system.

MAIN	amet	NCE .	AND	Oper.	ATIO1	r.						For the Year ending December 31, 1907.		
Administration,								•				\$12,018 78		
General supervision, .	•											5,795 05		
Faxes and other expenses,	•			•								35,198 61		
Wachusett Reservoir Depa	rtm	ent:	_											
General superintendence	,		•								\$5,101 81			
Superintendence, .											262 20			
Reservoir,											24,036 07			
Forestry,			•		•						7,141 45			
Protection of supply,		•	•		•						8,398 32			
Buildings and grounds,	٠.	•	•		•						2,453 30			
Wachusett dam, .	. '										6,176 34			
Wachusett aqueduct,		•									3,939 48			
Clinton sewerage system	:-													
Pumping station, .	•			•							4,459 95			
Sewers, screens and fil	ter-t	eds,	•		•	•					3,552 93			
Sanitary inspection, .		•									2,532 91			
Swamp drainage, .		•									897 23			
N-41 D												63,951 99		
Budbury Department: —										.				
General superintendence	•	•		•	•	•	•	•	•	•	\$3,414 04			
Superintendence, Framin	_		nce,	•	•	•	•	•	•	•	7,172 67			
Ashland Reservoir, .		•	•	•	•	•	•	•	•	•	1,768 05			
Hopkinton Reservoir,		•	•	٠	•	•	•	•	•	-	2,052 00			
Whitehall Beservoir,		٠.	•		٠	•	•	• •	•	٠	349 50			
Framingham Reservoirs					•	•	•	•	•	•	6,298 98			
Sudbury Reservoir, .	•	•	•	•	•	•	•	•	•	•	5,760 95			
	•	•	•	•	•	•	•	•	•	•	5,588 86			
Marlborough Brook filter	•	•	•		•	•	٠	•	•	•	1,763 38			
Pegan filters,		•	•		•	•	•	•	•	•	2,741 03			
Sudbury and Cochituate					•	•	•	•	•	•	8,711 00			
Sanitary inspection, .		•	•	•	•	•	•	•	•	٠	3,143 05			
Cochituate Aqueduct,	•	•	٠	•	•	•	•	•	•	•	8,001 57			
Sudbury Aqueduct,	•	•	•	•	•	•	•	•	•	•	6,776 69			
Weston Aqueduct, .	•	•	•	•	•	•	•	•	٠	•	5,784 42			
Biological laboratory,	•	•	•	•	•	•	•	•	٠	•	2,805 64	67,126 88		
Distribution Department:-	_											01,120 00		
General superintendence										.	\$10,144 28			
Superintendence	•							-	-		816 44			
Arlington Pumping stati			-	-	-				•		8,285 22			
Chestnut Hill low-service							r ser	vice.	•		84,070 16			
Chestnut Hill high-service											46,084 00			
Spot Pond pumping stati	-	-	-				_		, .		14,265 07			
West Roxbury pumping					-						7.028 93			
	•		•			,					86 81			
Bear Hill Reservoir,									·		178 94			
Chestnut Hill Reservoir,		:			-	•					13,423 51			
Fells Reservoir, .		•	:		:				•		421 85			
Forbes Hill Reservoir,			:	·	:	•	•	•	•	•	1,364 62			
Mystic Lake, conduit and						•	•	•	•		1,964 62			
	. pu	P-1	. B . C		., .	•	•	•	•	•	1,485 16			
			•	٠	•	•	•	•	•	•	\$139,089 61	\$184,091 26		

MAII	nten/	LNCE	AND	OPER	ATION	r <b>.</b>				.	For the Year ending December 31, 1907.		
Amounts brought fore	vard,				•				•		<b>\$139,089</b> 61	\$184,091 20	
Distribution Department	- c	onclu	ded.										
Waban Hill Reservoir,											773 85		
Weston Reservoir,											2,608 13		
Spot Pond,											9,974 11		
Buildings at Spot Pond	, .										545 83		
Spot Pond Brook, .											305 34		
Pipe lines: -											•		
Low service,											10,012 48		
Northern high service	э										2,935 95		
Southern high service								٠.			4,203 86		
Supply pipe lines, .											576 50	•	
Buildings at Chestnut I											2,474 88		
Chestnut Hill pipe yard											779 97		
Glenwood pipe yard an	d bu	ildin	gs,								4,973 04		
Stables,			•								5,945 94		
Waste prevention, .											66 35		
Venturi meters,				٠.							1,835 64		
Measurement of water,		•	•	•	•	•	•	•	•	•	2,141 83	189,242 8	
Total for maintaining	and	oper	atin	g wo	rks,							\$378,334 0	

# (7) DETAILED FINANCIAL STATEMENT UNDER METROPOLITAN WATER ACT.

The Board herewith presents, in accordance with the requirements of the Metropolitan Water Act, a detailed statement of the expenditures and disbursements, receipts, assets and liabilities for the year 1907.

# (a) Expenditures and Disbursements.

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1907, and ending December 31, 1907, is \$188,631.02, and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1907, is \$40,467,508.04.

For maintenance and operation the expenditures for the year have been \$373,334.07, and from the beginning of the work, \$3,024,296.31.

The salaries of the commissioners, and other expenses of administration, have been apportioned to the construction of the works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character:—

GENERAL CHARACTER OF EXPENDITURES.		ear ending r 31, 1907.	From Beginni to Decemb	ing of Work er 31, 1907.
CONSTRUCTION OF WORKS AND ACQUISI- TION BY PURCHASE OR TAKING.				
Administration.				
Commissioners,	\$2,333 33		\$112,643 58	
Secretary and auditor,	1,125 00		48,342 03	
Clerks and stenographers,	1,876 67		57, <del>44</del> 9 16	
Legal services,	-		2,359 00	
Travelling,	15 41		3,640 89	
Stationery and printing,	427 92		11,195 76	
Postage, express and telegrams,	58 10		2,807 17	
Furniture and fixtures,	-		4,280 89	
Alterations and repairs of buildings,	32 00		5,784 27	
Telephone, lighting, heating, water and	1			
care of building,	230 75		11,130 84	
Rent and taxes, main office,	239 80		4,857 01	
Miscellaneous expenses,	32 98	40.000.00	4,477 82	*****
Engineering.		<b>\$6,36</b> 6 96		<b>\$268,968 42</b>
Chief engineer and department engineers,	8655 80		\$207,171 36	
Principal assistant engineers,	8,996 28		155,603 89	
Engineering assistants,	16,307 15		1,023,465 97	•
Consulting engineers,	30 00		23,590 07	
Inspectors,	95 00		290,217 39	
Architects,	_		86,161 19	
Railroad and street car travel	25 42		26,804 91	
Wagon hire,	220 30		45,028 78	
Stationery and printing,	125 02		25,995 77	
Postage, express and telegrams,	19 92		7,728 88	
Engineering and drafting instruments and			.,	
tools, · · · · · · ·	23 25		19,308 03	
Engineering and drafting supplies	154 35		24,961 71	
Books, maps and photographic supplies, .	130 88		6,931 72	
Furniture and fixtures	1 00		14,978 46	
Alterations and repairs of buildings: -	1		'	
Main office,	69 00		14,107 86	
Sub-offices,	_		2,939 36	
Telephone, lighting, heating, water and care			į į	
of buildings: —				
Main office,	675 66		24,076 81	
Sub-offices,	175 96		19,622 32	
Rent and taxes, main office,	719 42		14,339 45	
Rent of sub-offices and other buildings, .	-		4,526 74	
Field offices and sheds,	-		1,274 49	
Clinton office building,	-		9,866 87	
Unclassified supplies,	_		8,240 53	
Miscellaneous expenses,	309 18		8,924 32	
		28,724 04		2,015,861 88
Amounts carried forward,	·	\$30,091 00		\$2,284,830 20

General Character of Expenditures.	December	ear ending : 31, 1907.	From Beginning of Work to December 31, 1907.		
Amounts brought forward,		<b>\$30,091</b> 00		<b>\$2,284,83</b> 0 2	
Construction.					
Preliminary work (borings, test pits and other investigations):—					
Advertising,	-		\$6,306 22		
Other preliminary work as given in detail			•		
in preceding annual report,	-		155,457 41	101 700 0	
Contracts, Wachusett Reservoir:				161,768 6	
Contracts completed and final payments					
made prior to January 1, 1907,	_		\$8,418,405 08		
McBride & Co., Stillwater improvement,	l -		23,814 67		
Sundry bills paid under this contract, .	\$17 15		8,476 60		
McArthur Bros. Co., Wachusett Dam,	625 31		1,606,481 04		
McArthur Bros. Co., item 26 in suit pend-	-				
ing in Superior Court,	8,331 23	•	3,331 23		
McArthur Bros. Co., building Sect. 2 of					
the relocation of Central Massachusetts					
Railroad,	311 61		286,521 00	- 041 - FOO -	
G		4,285 80		5,341,529 5	
Contracts improving Wachusett Water- shed:—			•		
A. McKenzie & Co., Sterling filter-beds, .	1	8,408 66		11,893 7	
Contracts completed, Wachusett Aqueduct,	İ	-	•	1,447,208 5	
Contracts completed, Sudbury Reservoir, .		-		1,545,028 3	
Contracts completed, protection Sudbury Supply:—					
City of Marlborough, main sewer,		-		9,000 0	
Contracts completed, improving Lake Co-					
chituate, :	1	-		60,657 4	
Contracts completed, protection Cochituate Supply:—					
Town of Framingham, low-level sewer, .		-		9,000 0	
Contracts completed, Rosemary siphon, .		-		5,916 9	
Contracts completed, pipe line, Dam No. 3					
to Dam No. 1,		-		17,240 2	
Contracts completed, Clinton sewerage sys-					
tem,	1	-		66,878 2	
Contracts, Weston Aqueduct:—					
Contracts completed and final payments					
made prior to January 1, 1907,	-		\$1,781,564 81		
Shanahan, Casparis & Co., Sect. 2,	_		201,827 74		
Sundry bills paid under this contract .	-		2,911 80		
Shanahan, Casparis & Co., Sect. 3,	_		126,420 70		
Sundry bills paid under this contract, .	_		4,214 78 108,983 26		
Shanahan, Casparis & Co., Sect. 6,	_		· ·		
Sundry bills paid under this contract, .	1		7,018 05 188,151 78		
Shanahan, Casparis & Co, Sect. 12, Sundry bills paid under this contract, .	1 -		8,339 77		
Sundry bins paid under this contract, .			0,000 11	2,874,877 1	
Amounts carried forward,	-	\$37,779 96		18,335,824	

GENERAL CHARACTER OF EXPENDITURES.		ear ending r 31, 1907.	From Beginning of Work to December 31, 1907.		
Amounts brought forward,		<b>\$37,779</b> 96		18,885,824 19	
Construction - Con.	İ				
Contracts, Distribution System: —					
Contracts completed and final payments	!				
made prior to January 1, 1907,	_		<b>\$4,387,773</b> 91		
C. A. Dodge & Co., Arlington pumping					
station,	\$18,307 77		29,498 21		
Hodge Boiler Works Co., horizontal re-			,		
turn tubular boilers,	6,694 00		6,694 00		
Allis. Chalmers Co., pumping engine, .	4,437 00		4,437 00		
		<b>29,43</b> 8 77	\$4,428,403 12		
Deduct value of pipes, valves, etc., included			\$1,220,200 1Z		
in above list, transferred to mainte-					
nance account December 31, 1900.	_		8,139 77		
				4,425,263 8	
Additional work:—	ļ				
Labor,	\$61,406 88		\$752,186 89		
Professional services, medical services,			-		
analyses, etc.,	88 98		1,857 99		
Travelling,	211 18		2,744 00		
Rent,	55 00		3,611 73		
Water rates,	-		1,454 77		
Freight and express,	293 52		12,944 51		
Jobbing and repairing,	48 93		9,668 08		
Tools, machinery, appliances, and hard-					
ware supplies,	830 67		78,942 77		
Electrical supplies,	-		4,924 68		
Castings, ironwork and metals,	5,848 47		79,413 71		
Iron pipe and valves,	2,449 08		60,367 69.		
Blasting supplies,	572 80		1,985 68		
Paint and coating,	1 75		4,316 43		
Fuel, oil and waste,	48 66		10,512 77		
Lumber and field buildings,	1,045 50		85,287 92		
Drain pipe,	63 06		9,150 37		
Brick, cement and stone,	1,227 87		26,388 79		
Sand, gravel and filling,	87 25		6,895 06		
Municipal and corporation work,	721 23		208,887 90		
Police service,	-		210,801 74		
Sanitary inspection,	90 00		13,100 09		
Judgments and settlements for damages,	5,860 40		52,624 26		
Unclassified supplies,	998 06		17,105 85		
Miscellaneous expenses,	1,486 01	83,884 80	5,929 10	1,656,052 2	
Legal and expert:—		. ,		, ,···- <del>-</del>	
Legal services	-		\$4,668 82		
Expert services,	_		1,862 66		
Court expenses,	· _	i	1,167 20		
Miscellaneous expenses,	\$14.75		185 80		
		14 75		7,884 4	
Amounts carried forward,	l	\$150,568 28	-	19,424,524 2	

General Character of Expanditures.		ear ending r 31, 1907.	From Beginning of Work to December 31, 1907.		
Amounts brought forward,		<b>\$150,568</b> 28	\$19,424,524 2		
Real Estate.					
Legal and expert:—					
Legal services,		}	<b>\$4,</b> 736 31		
Conveyancer and assistants,	. \$2,139 00		109,311 97		
Experts,			17,871 58		
Appraisers,	. 175 00		<b>22,832</b> 75		
Court expenses,	. 809 00		11,139 43		
Counsel expenses,	•   -		43 25		
Conveyancing supplies,	. 4 50		8,165 53	•	
Conveyancing expenses,	. 57 29		5,909 89		
Miscellaneous expenses,	.  -		4,195 81		
Settlements made by Board,	. 8,589 00		3,371,187 84		
Judgments,	. 2,240 49		168,682 24		
Taxes and tax equivalents,	.   -		68,182 41		
Care and disposal,	. 8,987 44	18,001 72	84,740 09	3,871,499 1	
Damages to Real Estate not taken, to Business and on Account of Loss of Wages.  Legal and expert:—  Legal services,	. \$1,222 54 . 1,662 55 . 12,885 00		\$1,180 67 2,857 62 14,157 84 414,330 32		
Judgments,	1,217 22	16,987 81	104,418 42	<b>536,</b> 889 8	
Claims on Account of Diversion of Water	•				
Legal and expert: —					
Legal services,	•   -		<b>\$3,774</b> 98		
Expert services,	•		19,339 69		
Court expenses,	• \$703 00		20,775 49		
Miscellaneous expenses,	. 995		1,289 58		
Settlements,	·   -		917,350 00		
Judgments,	2,860 76	3,073 71	220,719 67	1,183,249 4	
Purchase of Existing Water Works.		0,010 11		1,100,210 1	
Legal and expert:—	1				
Legal services,	.   -		<b>\$1,878 89</b>		
Expert services,			13,569 82		
Court expenses,	]  -		29,728 38		
Miscellaneous expenses,	] [		1,470 94		
Settlements and judgments,	.   -		15,227,100 01		
	.			15,273,748 0	
Relocation Central Massachusetts Railroad Settlements,	•	_		177,597 3	
•		_		211,001 0	
Total amount of construction expendi	-	A400 201 5		440 405	
tures,	•	<b>\$1</b> 88, <b>63</b> 1 <b>02</b>		<b>\$4</b> 0,467,508 0	

GENERAL CHARACTER OF EXPENDITURES.		For the Year ending December 31, 1907.				
Maintenance and Operation of World	KS.					
Administration:—				- 1		
Commissioners,				$\cdot$	<b>\$3,500 00</b>	
Secretary and assistants,				•	4,628 51	
Postage, printing, stationery and other supplies,		•		•	974 88	
Travelling,				.	1,725 19	
Telephone, heating, lighting and care of building,				.	574 46	
Alterations and repairs of building,		•		.	190 98	
Rent and taxes, office building,				.	859 70	
Miscellaneous expenses,					65 61	\$12,018 7
Supervision and general superintendence:—						
Chief engineer and department engineers,					<b>\$6,323 45</b>	
Engineering, clerical and laboratory assistants,					10,160 47	
Postage, printing, stationery, office and laboratory su	pplies	8, .			1,595 26	
Telephone, heating, lighting and care of offices, .					2,751 94	
Travelling and incidental expenses,					1,865 39	
Alterations and repairs of buildings,				$\cdot$	280 80	
Rent and taxes, main office,				$\cdot$	1,079 13	
Miscellaneous expenses,		•		•	898 74	24,455
Pumping service:						,
Labor,			,	$\cdot$	\$59,910 95	
Fuel,				.	42,733 85	
Oil, waste and packing,				.	1,248 07	
Repairs and renewals,				-	8,180 09	
Small supplies and expenses,			,	$\cdot$	1,887 02	
Rent, West Roxbury pumping station,			•		773 40	109,788 8
Superintendents and assistant superintendents,					\$4,522 72	100,100
Engineering assistants,				.	9,871 74	
Laboratory force,					2,258 67	
Sanitary inspectors,				.	3,903 78	
Recording and scientific instruments and supplies,				.	242 80	
Labor and teaming,					124,124 89	
Fools, machinery and appliances,			,		3,287 79	
Lumber and hardware supplies,				- 1	4,440 70	
Jobbing and repairing,				.	1,127 46	
Travelling,					2,107 88	
Horses, vehicles and stable expenses,					6,506 83	
Fuel, lighting and telephone,					4,042 65	
Municipal and corporation work,					1,129 95	
Unclassified supplies,					5,099 77	
Miscellaneous expenses,					7,778 06	
Conveyancer and assistants,			,		121 00	
Taxes and tax equivalents,			•		35,027 61	
Contracts and agreements,					10,507 00	
Contracts for pipes, valves, etc., bought from construct	ion w	ork	Binc	e		
January 1, 1907,		•	•		1,030 43	227,126
				Ī		
Total expenditures for maintenance and operation,				. 1		\$373,334 (

# (b) Receipts.

The total amount of receipts from rents, sales of property, etc., for the year beginning January 1, 1907, and ending December 31, 1907, is \$24,130.67; and the total amount from the time of the organization of the Metropolitan Water Board, July 19, 1895, to December 31, 1907, is \$524,436.88. The general character of these receipts is as follows:—

GENERAL CHARACTER OF RECEIPTS.	For the Yes December	•	From Beginning of Work to December 31, 1907.		
For distribution back to District: —					
District entrance fees,	-		<b>\$92,265 00</b>		
Supplying water outside of District, .	_		90,454 771		
Water furnished to water companies, .	-		87,145 88		
To the credit of the loan fund: -				<b>\$219,865 65</b>	
Real estate and buildings,	<b>\$720 00</b>		<b>\$34,361 46</b>		
Labor, tools, supplies and reimbursements,	9,326 70		124,046 65		
To the credit of the sinking fund: -		\$10,046 70		158,408 11	
Supplying water to cities and towns out-					
side of District and to water companies,	\$6,935 42		\$7,156 43 <sup>1</sup>		
Forfeiture for contracts awarded but not	-				
executed,	-		500 00		
Rents,	1,696 38		90,021 99		
Land products,	5,108 16.		45,602 11		
Unclassified receipts and interest,	844 01	14,083 97	2,882 59	146,163 12	
		<u> </u>			
Total receipts,	• • •	<b>\$24,130</b> 67		<b>\$524,436</b> 88	

<sup>1 \$221.01</sup> received in December, 1906, was placed in sinking fund by State Treasurer in 1907. See chapter 238, Acts of 1907.

The foregoing receipts have been credited to the various objects or works, as follows:—

Sources of Receipts.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.		
Admission into Metropolitan Water District (Quincy, Nahant, Arlington, Stoneham, Milton and Lexington), Supplying water to cities and towns outside of Water District (Swampscott, Revere, Lexington, Wakefield, Cambridge, Fram-	-	<b>\$</b> 92,265 00		
ingham and U. S. Government), and to water companies (Framingham, Milton and Revere),	\$6,935 42 \$6,935 42 \$6,935 42			

Sources of Receipts.			For the Year ending December 31, 1907.				From Beginning of Work to December 31, 1907.			
Amounts brought forwa	rd,			•			\$6,985	42		\$227,022 0
Construction and acquisitio	n of	wo	rks:-	_					•	
Administration,					\$67	96			\$110 11	
Wachusett Dam, .					1,059	60			6,684 48	
Wachusett Reservoir,					980	50			134,113 78	
Wachusett Aqueduct,					.	-			5,204 70	
Weston Aqueduct, .					149	50			5,012 63	
Sudbury Reservoir and w	ater	shed	i, .			-			7,735 42	
Distribution system, .			٠.		6,542	70			71,581 85	
Diversion of water, Cl	into	n se	were	ıge	1					
system, . `				•	90	00			1,367 94	
Purchase of existing wat	er w	orke	١, .		215	90			17,569 53	
Maintenance and operation	of	vork	·a ·			<del>,</del>	9,106	16		249,380 4
Wachusett Aqueduct,				_	\$365	94			\$4,116 81	
Wachusett Reservoir.		•	•	•	4,531				19.053 83	
Sudbury system, .		-	·	·	1,802			i	11,812 97	
Distribution system		·	•	·	649				9,120 47	
Clinton sewerage system,		•		·	789				3,930 28	
Cirrion Scholage by Stein,	•	•	•	•			8,089	09		48,034 3
Total receipts,							\$24,130	67		\$524,436 8

#### (c) Assets.

The following is an abstract of the assets of the Water Works, a complete schedule of which is kept on file in the office of the Board:—

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; police supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; real estate connected with works not completed; completed works, including real estate and buildings connected therewith.

#### (d) Liabilities.

There are liabilities as follows: --

There are other current bills unpaid which have not yet been received.

Amounts have been agreed upon in the following cases, but the deeds have not yet passed: Henry B. Stone, \$12,500; town of West Boylston, \$800.

On the claims of the following it is impossible to state the amounts due for land damages, water rights and claims for damages to established business, as no sums have been agreed upon, and suits are now pending in court for the determination of most of them:—

Charles C. Landy, Houghton Bros., Robert Johnston, John F. O'Brien, Patrick Bradley, Thomas H. Burgess, Lucy A. Wood, Joseph O. Bullard et al., Elwin I. Chase, Alzina A. Wilson, Henry F. Keyes, Robert C. Houghton et al., James E. Welch, Bridget M. Joyce, Byron D. Allen, J. Frank Wood et al., Asa Knight, Mary J. Fyfe, estate of William E. Fyfe, George M. Plummer, Edward F. Merriam, James A. Bigelow, William H. Brigham, John Fitzgerald, estate of Charles H. Hastings, George R. Hastings, William H. Hastings, Henry J. Hyde, Everett and Oliver S. Kendall, Sanford C. Kendall, estate of John A. Wood, estate of William H. Vickery, James H. and Hannah S. Wood, Asenath M. Bartlett, estate of Charles I. Longley, estate of Daniel M. Marsh, Francis W. M. Goodale, McArthur Bros. Co., Sarah Hourty, Clara L. Kingsbury, George W. Shattuck, Samuel F. Mason, Nellie M. Kirby, Willis A. Fuller.

#### VI. METROPOLITAN SEWERAGE WORKS.

No changes in territory have been made in the districts contributing to the North Metropolitan System and the South Metropolitan System which comprise the Metropolitan Sewerage Works.

The North Metropolitan System provides for the district situated largely in the Charles River and Mystic River valleys lying north of the Charles River, and embraces the cities of Cambridge, Chelsea, Everett, Malden, Medford, Melrose, Somerville, Woburn and parts of Boston, and the towns of Arlington, Belmont, Revere, Stoneham, Wakefield, Winchester, Winthrop and part of Lexington, — 9 cities and 8 towns. The district has an area of 90.50 square miles. It has an estimated population, as of December 31, 1907, based upon the census of 1905, of 498,640; and it is estimated that of this number 422,065, or 84.6 per cent., contribute sewage to the North Metropolitan System.

The South Metropolitan System provides for the areas situated in the Charles River valley lying south of the Charles River, a small portion of the valley north of the Charles River, and also a portion of the Neponset River valley; and embraces the cities of Newton, Quincy and Waltham, portions of the city of Boston, and the towns of Brookline, Hyde Park, Milton, Watertown and parts of Dedham, — 4 cities and 5 towns. This district has an area of 100.87 square

miles. It has an estimated population, as of December 31, 1907, of 325,090, of which number it is estimated that 188,150, or 57.9 per cent., contribute sewage to the South Metropolitan System.

#### (1) NORTH METROPOLITAN SEWERAGE SYSTEM — CONSTRUCTION.

#### (a) Malden Extension Sewer.

The extension of the North Metropolitan System, authorized by chapter 319 of the Acts of the Legislature of the year 1906, from a point near the centre of the city of Malden to an outlet into the waters of the Malden River, was finally completed at the beginning of the year, and sewage was received into the sewer on January 5, 1907. The necessary resurfacing and paving of streets and other work required in private lands along the line of the sewer were made during the spring, but the sewer has been maintained as a part of the North Metropolitan System continuously since it was first put into operation. The sewer has an entire length of 2,950.5 feet, and is built with a diameter varying from about 2.5 feet to 4.5 feet. The total expenditures for the construction of this sewer have amounted to \$53,879.45, and there is a small amount still payable. The sum paid includes damages on account of the taking of real estate, which have thus far aggregated the sum of \$4,150.

# (b) Construction of Bulkhead and Filling of Chelsea Street Flats.

The establishment by the United States Government of a pier-head line along Chelsea Creek has enabled the Board to fill in a considerable additional portion of the lot belonging to the Commonwealth on the northwesterly side of Chelsea Street which has been occupied for locker and stable buildings. A timber bulkhead has been constructed upon the lines laid down, and a considerable portion of the area enclosed has been filled. By this work the available area of the lot has been increased from about 10,000 square feet to an area of about 38,600 square feet. This work has so far been accomplished by the expenditure of \$3,231, and the value of the lot has been greatly enhanced.

# (2) South Metropolitan Sewerage System — Construction.

# (a) Extension of the High-level Sewer.

The work of the extension of the High-level Sewer in accordance with the requirements of chapter 406 of the Acts of the year 1906,

• • . •





SEWER CONSTRUCTION IN TRENCH ON COLUMBIA STREET, BROOKLINE-HIGH LEVEL SEWER EXTENSION.

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from the main line of the sewer in Centre Street in Jamaica Plain through parts of Wess Roxbury, Brookline and Brighton, has been in progress during the year.

The construction of the first section in West Readury near Jamaica Pond, which presented peculiar difficulties on account of the presence of quicksand, gravel and clay, had been begun by day labor under the direct supervision of the engineers of the Board. This section is wholly in tunnel, and passes Jamaica Pond at a depth of 35 feet below the ordinary surface of the pend. It is constructed under the pneumatic process by the introduction of compressed air. The work has thus far been successfully prosecuted, and it is expected that this section will be completed by day labor in the coming summer.

Another portion of the sewer, which consisted in the building of a tunnel through Commonwealth Avenue and Warren Street in the Brighton district, largely in rock excavation, was constructed by the Board by day labor, because the bids for the construction of this part of the sewer had been so greatly in excess of the estimates of cost made by the engineer. This portion of the work has also been successfully completed under the immediate direction of the Board within the engineer's estimates.

Contracts have been made during the year for the construction of all the remaining portions of the sewer from its junction with the main line as far as Oak Square in Brighton, except for a short section near Oak Square about 2,450 feet in length.

Several of these contracts were made in the middle of the summer, and have been substantially completed. The terms of the other contracts which were made towards the end of the season require their completion during the year 1908.

A length of 2.24 miles of the 5.64 miles of sewer, upon which construction has been entered, has been completed. The construction on the High-level Sewer extension during the year has called for the expenditure of \$445,059.17.

### (b) Quincy Pumping Station.

The new centrifugal pump purchased from the Lawrence Machine Company, having a capacity of pumping 10,000,000 gallons per 24 hours, was in the early part of the year fully installed in connection with the compound vertical engine, both engine and pump being of a

SEWER CONSTRUCTION IN TRENCH ON COLUMBIA STREET, BROOKLINE-HIGH LEVEL SEWER EXTENSION.



from the main line of the sewer in Centre Street in Jamaica Plain through parts of West Roxbury, Brookline and Brighton, has been in progress during the year.

The construction of the first section in West Roxbury (near Jamaica Pond), which presented peculiar difficulties, on account of the presence of quicksand, gravel and clay, had been begun by day labor under the direct supervision of the engineers of the Board. This section is wholly in tunnel, and passes Jamaica Pond at a depth of 35 feet below the ordinary surface of the pond. It is constructed under the pneumatic process by the introduction of compressed air. The work has thus far been successfully prosecuted, and it is expected that this section will be completed by day labor in the coming summer.

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### (b) Quincy Pumping Station.

The new centrifugal pump purchased from the Lawrence Machine Company, having a capacity of pumping 10,000,000 gallons per 24 hours, was in the early part of the year fully installed in connection with the compound vertical engine, both engine and pump being of a

standard type. Two additional boilers of about 100 horse-power each were supplied. The whole additional plant has been in operation since March 1, 1907.

# (3) Acquisition of Lands and Settlements for Lands Acquired.

During the year there have been made 5 takings of land and easements, all in Brookline, for the purposes of the extension of the High-level Sewer. These takings embrace 0.362 of an acre in fee, and easements in 12.30 acres, most of which were in public streets.

The following is a list of the takings: -

List of Takings for Metropolitan Sewerage Works for the Year 1907.

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Purpose of Taking.
16	Brookline, — Park Street from Bea- con Street to Washington Street. Area, easements in 1.68 acres.	Public street.	1907. Mar. 12.	Part of Section 82, South Metropoli- tan System.
17	Brookine, — from the end of a strip in which easements have been taken for the Metropolitan Sewer at the Boston line, through Colum- bia Street, land of Henry S. Cool- idge et al., Winchester Street and Beacon Street, to Park Street at the end of strip in which ease- ments were taken by Taking No. 16. Area, fee in 0.362 acre, ease- ments in 3.78 acres.	Henry S., Walter G. and Ellen G. Cool- idge and public streets.	Mar. 28.	Section 33 and part of Section 34, South Metropolitan Sys- tem.
18	Brookline, — from the end of a strip in which sewer easements were taken in Park Street by Taking No. 16, through Washington Street, Greenough Street and Gorham Avenue to a point near Davis Avenue. Area, easements in 1.83 acres.	Public streets.	May 20.	Part of Section 82, South Metropoli- tan System.
19	Brookline, — from the end of a strip in which sewer easements were taken in Gorham Avenue, through Davis Avenue, land of the town of Brookline, Tappan Street, land of Brookline, of the Boston & Al- bany Railroad Company and of George A. Goddard, Brington Road, Cypress Street and Kendall Street to Franklin Street. Area, easements in 3.08 acres.	Town of Brookline, Boston & Albany Railroad and George A. Goddard. Public streets.	July 5.	Parts of Sections 81 and 82, South Met- ropolitan System.
20	Brookline,—from a strip in which sewer easements were taken in Kendall Street by Taking No. 19, through Kendall Street and Chestnut Street to the Boston line, at the end of a strip in which sewer easements were taken by Taking No. 13. Area, easements in 1.98 acres.	Public streets.	Nov. 8.	Part of Section 81, South Metropoli- tan System.

Since January 1, 1907, settlements on account of the takings made in the North Metropolitan District have been effected in 2 cases, involving a payment of \$2,150; and in 1 case in the South Metropolitan District a settlement has been effected, under which payment has been made amounting to \$5,582.20.

Of the 3 sewerage settlements, 2 were on account of the sewer extension to Malden and 1 on account of the extension of the High-level Sewer in Brookline.

LOCATION.	Area in Acres.	Number of Settlements.	Payments.	
North Metropolitan District. Malden,	0.056	2	<b>\$2,150 00</b>	
South Metropolitan District.				
Brookline,	0.362	1	5,582 20	
Aggregate,	0.418	3	<b>\$</b> 7,732 20	

Summary of Land Settlements for the Year 1907.

### (4) North Metropolitan System — Maintenance.

There are now maintained in the North Metropolitan System 58.57 miles of main sewers, with which are connected 624.74 miles of local sewers, the number of connections, public and special, with the North Metropolitan System being 638.

The East Boston and Charlestown districts of Boston and the cities of Everett, Cambridge, Somerville and Chelsea still maintain both separate and combined sewers, but all of the other municipalities in the North Metropolitan System maintain separate sewers.

There have been pumped at the Alewife Brook pumping station 4,123,000 gallons of sewage per day, with an average lift of 12.90 feet, at a cost of \$0.344 per million gallons per foot lifted; at the Charlestown station 32,600,000 gallons per day, 8.31 feet lift, at a cost of \$0.168 per million gallons per foot lifted; at the East Boston station 62,300,000 gallons per day, 16.74 feet lift, at a cost of \$0.081 per million gallons per foot lifted; and at the Deer Island station 64,300,000 gallons per day, 10.79 feet lift, at a cost of \$0.097 per million gallons lifted. There has continued to be a decided increase in the amount of sewage pumped in all of the stations, but the increase has particularly occurred in the East Boston and Deer Island stations, where the excess has been upwards of 6,000,000 gallons daily over

the quantities of last year. The increase in the amount of sewage at East Boston has exceeded by 11 per cent. and that at the Deer Island station has exceeded by more than 10.5 per cent. the quantities discharged last year. There has been a greater cost of pumping, on account of the increased cost of labor and also the increased cost of coal.

The amount of sewage discharged in the North Metropolitan District averaged 152 gallons per day for each person, taking the estimated population of the district contributing sewage. If the sewers in this district were restricted to the admission of sewage proper only, and all local sewers were separate sewers, this per capita amount would be considerably decreased.

During the year 5 public and 13 special connections from local sewers have been made with the system, and 30.86 miles of local sewers have been added to those already connected with its works.

The extension of the main sewer, which receives the sewage of the town of Wakefield, from a point near the centre of the city of Malden to tide water, was completed at the beginning of the year, and has since been in continuous operation.

The cost of maintenance of the North Metropolitan System during the past year was \$138,271.99, which is somewhat more than the cost of maintenance for the preceding year.

### (5) SOUTH METROPOLITAN SYSTEM - MAINTENANCE.

In the South Metropolitan System there are maintained 40.25 miles of main sewers, with which are connected 479.51 miles of local sewers, having 111 connections with the Metropolitan System.

The Back Bay, Roxbury, West Roxbury, Brighton and Dorchester districts of Boston and the towns of Brookline and Milton still maintain both separate and combined sewers, but all the other districts contributory to this system maintain separate sewers.

The Ward Street pumping station, the Quincy pumping station and the screen-house at Nut Island are maintained for the disposal of sewage for this system.

There have been pumped at the Ward Street station an average of 23,500,000 gallons per day, with an average lift of 41.57 feet, at a cost of \$0.074 per million gallons per foot lifted; and at the Quincy station 3,615,000 gallons, 21.04 feet lift, at an average cost of \$0.254 per million gallons per foot lifted.

An average of 40,600,000 gallons of sewage has passed daily through the screens at the Nut Island screen-house, and has been discharged from the outfalls into the outer harbor. The maximum discharge per day, which occurred during a heavy storm, was 137,000,000 gallons. The discharge of sewage through the outfalls represents the amount of sewage contributed in the South Metropolitan System, which was at the rate of 215 gallons per day per person of the estimated number contributing sewage in the District. The daily discharge of sewage per capita is considerably larger in the South Metropolitan District than it is in the North Metropolitan District, because, owing to the large size of the High-level Sewer, more storm water is admitted at periods of heavy rainfall.

The additional pumping engine which has been obtained for the Quincy station has been in operation since March 1, and has been successful in relieving the station from the troubles which had occurred, particularly in periods of unusual rainfall.

A small area in the districts of Dorchester and town of Milton, which is so low that its sewage cannot be carried into the High-level Sewer except by pumping, still disposes of its sewage through the Boston Main Drainage Works, and for this a rental is paid to the city of Boston. Otherwise, all the sewage of the South Metropolitan Sewerage District is disposed of through the outfall pipes from Nut Island.

The expenditures for maintenance of the South Metropolitan System for the past year were \$95,513.11.

#### VII. SEWERAGE WORKS - FINANCIAL STATEMENT.

The financial abstract of the receipts, expenditures, disbursements, assets and liabilities of the Metropolitan Water and Sewerage Board for the fiscal year of the Commonwealth ending with the thirtieth day of November, 1907, was, as stated in connection with the Water Works, presented to the General Court in January, in accordance with the requirements of chapter 235 of the Acts of the year 1906, and a copy of this financial abstract is in part printed as Appendix No. 5.

The following statement of its financial doings, in relation to the Metropolitan Sewerage Works, for the calendar year 1907, is herewith presented, in accordance with the provisions of the Act of 1906, as a part of the annual report of the Board. The Metropolitan sewerage loans for the construction of the Sewerage Works of the North Metropolitan System have amounted to \$6,160,865.73, to which are added receipts from various sources amounting to \$17,153.40. The amount of expenditures approved by the Board for payment for the year 1907 was \$9,822.86, and the total amount of expenditures approved to January 1, 1908, was \$6,146,023.16. The balance on hand on January 1, 1908, was \$31,995.97.

The loans for the construction of the various parts of the South Metropolitan System have amounted to \$8,867,046.27. The receipts applicable to the loan fund have been \$10,106.60. The amount of expenditures approved for payment in the year 1907 was \$459,807.64. The total amount of expenditures approved for payment from the beginning of the works has been \$8,182,580.79. The balance on hand for the South Metropolitan System on January 1, 1908, was \$694,572.08.

The bonds issued on account of the loans have been for varying periods, not exceeding forty years, and bear interest at the rate of 3 per cent. and 3½ per cent. The premiums received on account of the sale of bonds on the North Metropolitan System have amounted to \$175,518.65, and those received on account of the South Metropolitan System have amounted to \$400,332.03.

The amount expended for maintenance of the North Metropolitan System in the year 1907 was \$138,271.99, and for the South Metropolitan System \$95,513.11, a total for both systems of \$233,785.10.

The assessments made to meet interest, sinking fund requirements, and maintenance and operation of the North Metropolitan System amounted in the year 1907 to \$270,448.12, and the assessments for the South Metropolitan System amounted to \$503,860.49.

The following is a detailed financial statement regarding the Metropolitan Sewerage Works:—

(1) Metropolitan Sewerage Loans, Receipts and Payments. The loans for the construction of the Metropolitan Sewerage Works, the receipts which are added to the proceeds of these loans, and the expenditures for construction, have been as follows:—

(a) North Metropolitan System.		
Loans under various acts of the Legislature (given in detail in		
report for the year 1901),	\$5,605,865	73
Loans under chapters 242, 336 and 399, Acts of 1903,	500,000	00
Loan under chapter 319, Acts of 1906,	55,000	00
Proceeds from sales of property and from other sources to Decem-	•	
ber 31, 1907,	17,153	40
	<b>\$</b> 6,178,019	13
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to		
December 31, 1907 (of which \$9,822.86 is for the year 1907), .	6,146,023	16
Balance, North Metropolitan System, January 1, 1908,	<b>\$</b> 31,995	97
(b) South Metropolitan System.		
Loans under the Acts of the years 1889 and 1900 (Charles River		
Valley Sewer),	\$800,046	27
Loans under various acts of the Legislature (given in detail in		
report for the year 1901, Neponset River Valley Sewer),	900,000	00
Loan under chapter 315 of the Acts of 1903 (Neponset River		
Valley Sewer),	4,000	
Loan under chapter 424 of the Acts of 1899,	4,600,000	
Loan under chapter 356 of the Acts of 1903,	996,000	
Loans under chapters 230 and 246 of the Acts of 1904,	392,000	
Loan under chapter 406 of the Acts of 1906,	1,175,000	00
Proceeds from sales of property and other sources to December		
31, 1907 (of which \$3,228.13 is for the year 1907),	10,106	60
	\$8,877,152	87
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to		
December 31, 1907 (of which \$459,807.64 is for the year 1907),.	8,182,580	79
Balance, South Metropolitan System, January 1, 1908,	<b>\$</b> 694,572	08

### (2) Issues of Metropolitan Sewerage Loan Bonds.

The Treasurer of the Commonwealth, under the authority of the successive statutes, has from time to time issued bonds designated "Metropolitan Sewerage Loan," as follows:—

### METROPOLITAN SEWER LOANS, NORTH SYSTEM.

### Bonds issued.

DATE OF SALE.						of Ronda   towart (Don		Price received.	Date due.	Premium.	
Apr. 2,	1890, .			•		\$500,000	3	102.40	Jan. 1, 1980,	\$12,000 00	
Apr. 2,	1890, .	•	•		•	500,000	3	108.02	Jan. 1, 1980,	15,100 00	
Apr. 2,	1890, .					500,000	8	103.62	Jan. 1, 1980,	18,100 00	
Apr. 2,	1890, .					500,000	3	102.327	Jan. 1, 1980,	11,635 00	
Apr.,	1890, .					200,000	8	108.	Jan. 1, 1980,	6,000 00	
Feb.,	1891, .					50,000	3	104.	Jan. 1, 1930,	h	
Mar.,	1891, .					800,000	. 8	104.	Jan. 1, 1980,	35,130 8	
Mar.,	1891, .					18,000	3	104.	Jan. 1, 1930,	]]	
Jan.,	1892, .					35,000	8	100.	Jan. 1, 1930,	-	
Feb.,	1892, .					29,000	3	100	Jan. 1, 1930,	- 1	
Mar.,	1892, .				:	50,000	8	101.	Jan. 1, 1980,	500 00	
June,	1892, .					436,000	3	101.50	Jan. 1, 1930,	h	
July,	1892, .			•		150,000	3	101.50	Jan, 1, 1930,	11,060 00	
Aug.,	1892,					150,000	3	101.50	Jan. 1, 1930,	IJ	
Nov.,	1892, .					3,000	8	100.50	Jan. 1, 1930,	15 00	
Nov.,	1892, .					200,000	8	100.	Jan. 1, 1980,	-	
Jan.,	1893, .					85,000	8	100.50	Jan. 1, 1930,	175 0	
Jan.,	1893, .					25,000	3	100.50	Jan. 1, 1980,	125 0	
Feb.,	1893, .					20,000	8	101.	Jan. 1, 1930,	200 0	
Feb.,	1893, .					5,000	8	100.50	Jan. 1, 1930,	25 0	
Feb.,	1893, .					400,000	8	100.25	Jan. 1, 1930,	1,000 0	
Mar.,	1898, .					94,000	8	100.25	Jan. 1, 1980,	235 0	
May 1,	1894, .					464,000	8	100.	Jan. 1, 1980,		
Oct.,	1894, .					4,000	3	100.	Jan. 1, 1980,	_	
Oct.,	1894, .					1,000	8	100.	Jan. 1, 1980.	_	
Nov.,	1894, .					15,000	3	100.	Jan. 1, 1980,	-	
Nov.,	1894, .					10,000	8	100.	Jan. 1, 1930,	-	
Dec.,	1894, .					6,000	3	100.	Jan. 1, 1930,	_	
Apr.,	1895, .					300,000	3	100.	Jan. 1, 1930,	_	
Dec.,	1896, .					30,000	8	100.	Jan. 1, 1980,		
June,	1897, .					70,000	31/2	106.248	Jan. 1, 1930,	١,	
June,	1897, .					10,000	81/2	106.243	Jan. 1, 1980,	5,084 8	
Apr.,	1898, .					5,000	3	100.	Jan. 1, 1930,	5	
June,	1898					155,000	31/2	100.	Jan. 1, 1930,	22,848 78	
June.	1898.					60,000	31/2	100.	Jan. 1, 1980,	22,020 10	
Apr.,	1900,					265,000	3	103.948	Jan. 1, 1980,	10,462 20	
May,	1908,					200,000	31/2	104.9797	Jan. 1, 1980,	9,959 40	
May,	1903, .					50,000	31/2	106.2424	Jan. 1, 1943,	3,121 2	
July,	1903			•		250,000	31/2	104.419	July 1, 1943,	11,047 5	
June,	1906, .			•		55,000	31/2	103.09	July 1, 1943,	1,699 50	
,		•	-	-	-		_	100.00	our 1, 1090,	1,099.0	

<sup>1</sup> Readjustment of Treasurer.

# METROPOLITAN SEWER LOANS, SOUTH SYSTEM. Bonds issued.

DATE OF SALE.				Amount of Bonds sold.	of Bonds   terest (Per	Price received.				
Apr., 1890,						<b>\$100,000</b>	8	108.	Jan. 1, 1930,	<b>\$3,000</b> 0
Apr., 1890,					•	400,000	3	103.	Jan. 1, 1930,	<b>12,000</b> 0
Мау, 1890,		•			•	800,000	3	104.	Jan. 1, 1930,	12,000 0
Aug., 1895,		•		•		300,009	3	100.585	Mar. 1, 1985,	1,755 0
Feb., 1896,		•		•		50,000	8	100.	Mar. 1, 1935,	-
Dec., 1896,						135,000	3	100.	Mar. 1, 1985,	-
Dec., 1896,						15,000	8	100.	Mar. 1, 1985,	-
June, 1897,						800,000	31/2	106.98	Mar. 1, 1935,	20,940 0
June, 1898,						85,000	31/2	100.	Mar. 1, 1935,	4,088 0
June, 1899,						25,000	3	100.64	Mar. 1, 1936,	160 0
June, 1899,						1,000,000	3	100.64	July 1, 1939,	6,400 0
Sept., 1900,						10,000	8	100.79	July 1, 1939,	79 0
Sept., 1900,						912	3	100.	July 1, 1939,	-
Apr., 1901,						40,000	3	100.915	Mar. 1, 1936,	<b>366</b> 0
Sept., 1901,	•					2,000,000	31/2	106.71	July 1, 1940,	134,200 0
Sept., 1902,						14,000	3	100.	July 1, 1989,	-
Sept., 1902,						500,000	31/2	107.243	July 1, 1940,	36,215 0
Sept., 1902,						150,000	31/2	107.2395	July 1, 1940,	10,859 2
Dec., 1902,						200,000	81/2	107.79	July 1, 1940,	15,580 0
Feb., 1908,						100,000	31/2	108.25	July 1, 1940,	8,230 5
Apr., 1903,		•				100,000	31/2	106.75	July 1, 1940,	6,750 0
Apr., 1903,	•					175,000	81/2	106.75	July 1, 1940,	11,812 5
Apr., 1903,	•					208,000	31/2	106.75	July 1, 1940,	13,702 5
Apr., 1903,						25,000	31/2	106.494	July 1, 1940,	1,623 5
Apr., 1903,		•				133,000	31/2	105.9364	July 1, 1940,	7,895 4
May, 1908,						996,000	81/2	106.2424	Jan. 1, 1943,	62,174 3
May, 1903,						4,000	31/2	105.5453	Mar. 1, 1935,	221 8
July, 1904,						392,000	31/2	104.929	July 1, 1944,	19,321 6
une, 1906,						154,000	31/2	103.09	Jan. 1, 1946,	4,758 6
June, 1906,						21,000	31/2	108.092	Jan. 1, 1946,	648 9
pr., 1907,		•			•	300,000	31/2	101.85	Jan. 1, 1947,	5,550 0
						\$8,177,912	1 '		[	\$400,332 0

<sup>1</sup> Readjustment of Treasurer.

### (3) METROPOLITAN SEWERAGE LOANS SINKING FUND.

Under authority of chapter 122 of the Acts of 1899, and section 14 of chapter 424 of the Acts of 1899, the Treasurer of the Commonwealth was required to consolidate the sinking funds of all the Metropolitan sewerage loans into one fund, to be known as the Metropolitan Sewerage Loans Sinking Fund. The Board received, during the year, from rentals and from other sources, to be applied to the sinking fund, \$109.21.

<sup>2</sup> Not issued or delivered until 1907

The sinking fund established has amounted at the end of each year to sums as follows:—

December 31, 1899,	<b>\$361,416</b> 59	December 31, 1904,	<b>\$</b> 878,557 12
December 31, 1900,	454,520 57	December 31, 1905,	1,008,724 95
December 31, 1901,	545,668 26	December 31, 1906,	1,146,998 68
December 31, 1902,	636,084 04	December 31, 1907,	1,306,850 30
December 31, 1903,	754,690 41	•	

### (4) Annual Appropriations, Receipts and Expenditures.

The annual appropriations for the maintenance of the Metropolitan Sewerage Works, the receipts of the Board which are added to the appropriations for maintenance, and the expenditures for maintenance for the year ending December 31, 1907, have been as follows:—

### North Metropolitan System.

Appropriations under chapter 201 of the Acts of 19	07,				<b>\$143,000</b>	00
Receipts from pumping and from other sources,		•	•	•	1,225	04
					\$144,225	<u>04</u>
Amount approved by the Board for payment, .					138,271	<b>99</b> .
Balance January 1, 1908,	•		•		\$5,953	05
South Metropolitan Sys	tem	•				
Appropriation under chapter 200 of the Acts of 190	7,				<b>\$</b> 100,500	00
Receipts from pumping and from other sources,	•	•	•		23	<b>25</b>
					\$100,523	25
Amount approved by the Board for payment, .		•	•	•	95,513	11
Balance January 1, 1908,					<b>\$</b> 5,010	14

#### (5) Annual Assessments.

Assessments for the year, amounting to \$270,448.12 for the North Metropolitan System and to \$503,860.49 for the South Metropolitan System, were required for the payment of interest and sinking fund requirements and the cost of maintenance and operation of works. The requirements for the North Metropolitan System were: for interest, \$123,858.39; for the sinking fund, \$53,144.64; and for maintenance, \$93,445.09. For the South Metropolitan System the requirements were: for interest, \$367,726.72; for the sinking fund, \$48,198.97; and for maintenance, \$87,934.80. The assessments for the North Metropolitan System were made upon the cities and towns

in the District in accordance with chapter 369 of the Acts of the year 1906, and the assessments for the South Metropolitan System were made in accordance with ratios fixed by the Apportionment Commissioners appointed under the provisions of chapter 424 of the Acts of the year 1899, and the respective assessments were as follows:—

Notir	Metropoutan	Sewerage	System.
	40 101 05	G	

		<b>\$6,101 25</b>	Somerville,			<b>\$</b> 37,575 77	7
		3,408 53	Stoneham,			3,358 50	0
		47,151 90	Wakefield,			5,443 92	2
		64,323 01	Winchester,			6,051 02	2.
		17,399 54	Winthrop,		•.	4,932 39	9
		14,384 62	Woburn, .		-	7,487 56	6
		2,331 25	Revere, .			7,371 92	2
		20,965 22	-				_
		12,896 77	Total,			\$270,448 12	2
	•	9,264 95					
,	South	Metropolita	<b>Sewerag</b> e Sy	sten	ı.		
		\$207,194 36	Quincy,			\$29,239 00	0
		97,178 00	Waltham,			28,599 18	3
		12,232 39	Watertown,			14,702 71	1
	•	15,500 29	•				_
		24,702 32	Total,			\$503,860 49	9
		74.512 24					
		South	3,408 53 47,151 90 47,151 90 64,323 01 17,399 54 14,384 62 2,331 25 20,965 22 12,896 77 2,264 95  South Metropolitar 97,178 00 12,232 39 15,500 29 24,702 32			 	

# (6) Expenditures for the Different Works. The following is a summary of the expenditures made in

The following is a summary of the expenditures made in the various operations for the different works:—

Construction and Acquis Works.	ITION	O <b>F</b>			ear ending r 31, 1907.	From Beginning of Work to December 31, 1907.		
North Metropolitan Sy	stem							
Original system, main line and	bra	nches	, .	_			\$5,383,932 6	
Lexington branch,			.	-			68,585 1	
Everett branch,			.	-			54,877 1	
Wakefield branch,			.	-			35,698 2	
Stoneham branch,				_			11,574 1	
Chelsea and Everett outlets,				_			71,216 4	
Belmont extension,				-			57,153 0	
Malden extension : —								
Administration,				\$1,556 46		<b>\$3,610 46</b>		
Section 64,				2,689 80		45,829 94		
Land takings, purchase and	recor	ding,		2,274 45		4,439 05		
			ŀ		\$6,520 71		53,879 4	
Amounts carried forward,	:		.		\$6,520 71		\$5,736,916 2	

Construction and Acquisition of Works.	For the Ye December	-	From Beginning of Work to December 31, 1907.		
Amounts brought forward,		\$6,520 71	•	\$5,736,916 2	
North Metropolitan System — Con.					
Bulkhead, Chelsea Creek,		3,281 00		3,231 00	
Stable and locker, East Boston,		71 15		71 1	
Revere extension,		-		215,722 79	
Wakefield branch extension,		-		190,081 97	
Total North Metropolitan System, .		\$9,822 86		\$6,146,028 16	
South Metropolitan System.					
Charles River valley sewer, main line,	-		•	\$800,046 2	
Neponset River valley sewer:					
Main line,	-		<b>\$866,595</b> 66		
Brookline branch,	-	•	44,985 80	211 501 4	
High-level Sewer: —		}		911,581 4	
Administration,	<b>\$27</b> 86		\$51,621 43		
Apportionment commission,	-	1	2,000 00		
Land takings, purchase and recording, .	126 68		355,501 45		
Quincy force main,	-		18,351 71		
Quincy pumping station,	9,564 14		11,705 68		
Section 43, Quincy,	· _		411,749 22		
Section 44, Quincy,	-		299,543 47		
Section 45, Quincy,	-		76,189 36		
Section 46, Quincy,	-		62,551 26		
Section 47, Quincy,	-		109,786 58		
Section 48, Quincy,	-		295,319 29		
Sections 48 and 49, embankments, Quincy,	_		81,548 64		
Section 49, Quincy,	-		169,020 18		
Section 50, Quincy,	-		109,570 35		
Section 51, Quincy,	-		87 <b>,203 6</b> 8		
Section 52, Quincy,	-		155,800 65		
Section 53, Quincy,	-		98,042 42		
Section 54, Quincy,	-		101,918 89		
Section 55, Milton and Quincy,	-		805,816 90		
Section 56, Milton,	-		105,786 94		
Section 57, Milton,	-		68,783 24		
Section 58, Milton,	-		94,089 72		
Section 59, Milton,	-		104,444 62		
Section 60, Milton,	· -		60,796 13		
Section 61, Milton,	-	į	129,598 76		
Section 62, Milton,	-		129,612 28		
Section 63, Milton,	. <b>-</b>		127,142 45		
Section 64, Neponset River crossing, .	-		47,554 40		
Section 65, Hyde Park,	-		41,833 87		
Section 66, Hyde Park,	-		258,902 72		
ing,	_		\$2,298 33		
Section 68, Hyde Park and Roxbury,	-		78,493 62		
Section 69, West Roxbury,	_		102,143 68		
Section 70, West Roxbury,	-		181,875 55		
Amounts carried forward,					

Construction and Acquisition of Works.	1		ar ending 31, 1907.	From Beginning of Work to December 31, 1907.		
Amounts brought forward,	\$9,718	63		\$4,310,496 47	\$1,711,577 78	
South Metropolitan System - Con.						
High-level Sewer — Con.					•	
Section 71, West Roxbury,	-			91,888 22		
Section 72, West Roxbury,	-	•		127,956 76		
Section 73, West Roxbury,	-			494,290 42		
Section 74, West Roxbury and Roxbury, .				147,296 69		
Section 75, Roxbury,	-			137,192 99		
Section 76, Roxbury, cast-iron force main,	-			80,342 26		
Section 77, Roxbury, Ward Street pump-				f		
ing station,	5,029	84		560,288 31		
Section 78, Roxbury, connecting sewer, .				85,994 69		
Reversion of grade, Huntington Avenue,	-			6,508 56		
High-level extension: —	<del></del>	_	\$14,748 47		5,992,250 37	
Charles River valley studies,				\$3,898 71		
Administration,	\$6,332	17		6,382 17		
Section 80, day work, West Roxbury and						
Brookline,	177,405	52		200,045 89		
Section 81, Brookline,	2,831	44		4,219 16		
Section 82, Brookline,	112,634	88		114,022 60		
Section 82, day work, Park Street crossing,	2,019	54		2,019 54		
Section 88, Brookline,	28,989	24		30,376 96		
Section 84, Brookline and Brighton,	48,664	87		45,052 59		
Section 85, Brighton,	746	63		746 63		
Section 85, day work, Brighton,	64,646	05		66,254 61		
Section 86, Brighton,	41			41 00		
Land takings, purchase and recording, .	5,747	83		5,747 83		
		<b></b>	445,059 17		478,752 69	
Total for South Metropolitan System, .		٠ _	\$459,807 64		\$8,182,580 79	
Total for costruction for both systems,	<b> </b>	. •	<b>\$469,630</b> 50		\$14,328,603 90	

Maintenance.	For the Year ending December 31, 1907.	From Beginning of Work to December 31, 1907				
North Metropolitan System,			•		\$138,271 99	\$1,266,243 79
South Metropolitan System,					95,513 11	1,114,060 05
Total for maintenance, both systems,	•	•	•		\$233,785 10	\$2,380,303 84

### (7) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Sewerage Acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year ending December 31, 1907:—

### (a) Expenditures and Disbursements.

General Character	0 P	Exp	ENDIT	TURBS	•				For the Ye	
CONSTRUCTION OF WORKS AND		ous:	ITIO	N BY	Pur	CH	ASE O	R.		
North Metrope	lita	n Sr	/stem	٠.				1		•
Administration: —										
Commissioners,	•	•	•	•	•	•	•		\$1,168 67	
Clerks and stenographers,	•	•	•	•	•	٠	•	٠ ¦	235 00	
Stationery and printing,	•		٠.	. •	•	٠	•		42 32	
Telephone, lighting, heating, water	r an	d ca:	re of	bull	ding,	•	•	•	20 88	
Rent and taxes, main office,	•	•	•	•	•	•	•		90 59	
Miscellaneous expenses,	•	•	•	•	•	•	. •	•	1 00	\$1,556 46
Engineers, inspectors, rodmen, labo	rers	and	othe	rs,			••		\$524 12	φ1,000 ±0
Advertising,								.	8 50	,
Office supplies,			•					.	81 15	
Books, maps, plans and blueprints,		•			•			•	16 32	
Engineering supplies,	•				•			.	3 56	
Rent and taxes, Ashburton Place,	•		•		•	•	•	•	272 00	
Brick, cement, lumber and other fiel	d su	ppli	es,	•	•	•	•	•	158 60	
Teaming and express,	•	•	•		•	•	•		10 50	
Contracts: —										
T. H. Gill & Co., Section 64, .	•		•	•	•	•	<b>\$1,048</b>	18		
Sundry bills paid under this con			•	•	•	•	643	02		
Lawler Bros., bulkhead Chelsea C	reek	, .	•	•	•	•	3,231	00	4 000 00	
Land takings, purchase and recording									4,922 20	
Experts and appraisers,	цg,	•	•	•	•	•	•	•	2,174 45 100 00	
maper as and appraisers,	•	•	•	•	•	•	•		100 00	8,266 40
Total for North Metropolitan Sys	tem		•	•	•		•			\$9,822 86
South Metrope	olita	n Sz	/stem	١.						
Administration :	Sew	er : -	-							
Telephone, lighting, heating, wate		d	ma a#	hmil.	Ain		410			
Miscellaneous expenses,				Dui	uing,	•	<b>\$</b> 16	90		
	•	•	•	•	•	•			\$27 86	
Engineers, inspectors, rodmen, labo		and	othe	rs,	•	•	<b>\$1,</b> 631	- 1		
Tools and repairs of same,	•	•	•	•	•	•	59			
Brick, cement, lumber and other fiel	d su	ppli	es,	•	•	•	12,846	- 1		
Teaming and express,	•	•	•	•	•	•	57	- 1		
Land takings, purchase and recordi	ng,	•	•	•	•	•	126	63	14,720 61	
W-1-1			•							\$14,748 47
Administration: — High-level Sewer	EX	iens:	ion:	_						
Commissioners,						,	\$2,333	33		
Secretary,							375	- 1		
Clerks and stenographers, .							2,099	- 1		
Traveling,							8			
Stationery, printing and office sup	plies	١,					833	- 1		
Amounts carried forward, .	-					-				\$14,748 47
Amounts curricu jorwaru, .	•	•	•	•	•		<b>\$5,64</b> 9	19		<b>⊕13,130 €</b> (

General Character of Expen	DITUR	<b>28.</b>	`	For the Ye	•
Amounts brought forward,			\$5,649 19		\$14,748 47
South Metropolitan System -	Coi	a.			
. High-level Sewer Extension -	– Cor	١.		1	
Administration — Con.	- 00.	••			
Telephone, lighting, heating, water and care	of t	mild.		<u> </u>	
ing,			343 10		
Rent and taxes, main office,			298 58		
Miscellaneous expenses,			46 85		•
Engineering: —				\$6,832 17	
Chief engineer,			\$3,333 33	i	
Engineering assistants,	•	•	23,710 75		
Inspectors,		•	4,784 19		
Traveling expenses,		•	361 46		
Stationery, printing and office supplies,			1,027 44		•
Engineering and draughting instruments an	d too	la.	151 00		
			155 22		
Telephone, lighting, heating, water and care		nild-	200 22		
ing,			1,390 58		
Rent and taxes,			1,079 14		
Miscellaneous expenses,			745 91		
- ·				36,689 02	
Advertising,	•	•	\$411 67 190 061 40		
Tools, machinery and appliances,	•	•	189,061 49 2,308 00		
Brick, cement, lumber and other field supplie	a an	· ·	2,000 00	•	
penses,			87,997 00		
Contracts:—		•	01,001		
Hugh Nawn Contracting Co., Section 81, in p	art		1,496 00		
James Driscoll & Son, Section 82, in part, .			36,755 84		
Timothy J. O'Connell, Section 82, in part, .			26,122 68		
Timothy J. O'Connell, Section 82, in part,			38,085 05		
Chas. G. Craib & Co., Section 83, in part, .			23,225 85		
Timothy J. O'Connell, Section 88, in part, .			2,085 05		
D. F. O'Connell, Section 84,			38,741 52		
Real estate: —				396,290 15	
Settlements,			\$5,582 20		
Legal, conveyancing and expert,			165 63		
		-		5,747 83	
					445,059 17
Total for South Metropolitan System,	•	•			\$459,807 64
Maintenance and Operation	of W	ORK	3.		
North Metropolitan Syst	em.		•		
Administration: —					
Commissioners, secretary and assistants,		•		<b>\$5,661</b> 67	
Postage, printing, stationery and office suppl	-			543 18	
Rent, telephone, heating, lighting and care of	t buil	ding,		578 86	
Miscellaneous expenses,		•		61 35	
					\$6,845 06
Amount carried forward,				١	\$6,845 06

	Gun	ERAL	CHAI	RACTI	e of	Exp	andi:	rur <b>r</b> e	١.				For the Yes December	
Amount br	ought	forw	ard,				•	•						<b>\$</b> 6,845 0
	No	orth .	Metro	polit	an S	yste	m (	Con.						
General super	ntende	ence	:-											
Chief engine					•		•			•	•		\$6,182 12	
Postage, pri										•	• •	•	219 23	
Rent, telepho				hting	and	care	of t	uild	ing,	•	•	٠	1,618 04	
Miscellaneou	s expe	nses	, .	•	•	•	•	•	•	•	•	٠	481 80	
Deer Island pt	ımping	g stat	ion : -	_										8,450 6
Labor, .													\$13,751 21	
Coal,		•	•	•	•	•	• •						9,220 83	
Oil and wast	е, .	•	•	•	•	•	•		•	•	• `		410 75	
Water, .	•	•				•	•	•		•	•		1,117 20	
Packing, .	•	•	•	•	•	•	•	•	•	•	•	•	168 06	
Repairs and		•	•	•	•	•	•	•	•	•	•	٠	1,659 85	
Telephone a				-	•	•	•	•	•	•	•	•	183 33	
Miscellaneou				-	18 <b>68</b> ,	٠	•	٠	•	•	•	•	1,523 56	
East Boston p	-	g sta	tion :	_										
•	. •	•	•	•	•	•	•	•	•	•	•	٠	16,885 79	
Coal,		•	•	•	•	•	•	•	•	•	•	٠	11,971 71	
Oil and wast		•	•	•	•	•	•	•	•	•	•	٠	408 57	
•	•	•	•	•	•	•	•	•	•	•	•	٠	1,896 80	
Packing, .			•	•	•	•	•	•	•	•	٠	•	44 87	
Repairs and		-	•	•	•	•	•	•	•	•	•	٠	1,885 09	
Telephone a					•	•	•	•	•	•	•	٠	184 52	
Miscellaneou				-	ses,	•	•	•	•	•	•	•	1,144 10	
Charlestown p		-	uion:	_									141=0.0=	
	•	•	•	•	•	•	•	•	•	•	•	•	14,178 37	
Coal,	•	•	•	•	•	•	•	•	•	•	•	•	4,485 49	
Oil and wast Water, .		•	•	•	•	•	•	•	•	•	•	•	288 67	
•	•	•	•	•	•	•	•	•	•	•	•	•	411 60	
Packing, . Repairs and			•		•	•	•	•	•	•	•	•	68 28	
•					•	•	•	•	•	•	•	•	746 64	
Telephone a						•	•	•	•	•	•	•	167 00	
Miscellaneou Alewife Brook				-	ses,	•	•	•	•	•	•	•	455 80	
	. pump	nug :	swamo	ш.—			٠						6,020 94	
Coal,		•	•	•	•	:	:	•	•	•	•	•	1,832 20	
Oil and wast		•	٠	:	•	•	•	•	•	•	•	•	189 33	
Water.		:	•	•	•	•	•	•	•	•	•	•	170 16	
Packing.		Ċ	•	•		•	•	Ċ	•	•	•		15 48	
Repairs and			•	·	:	•	•	•	·	·	•		150 85	
Telephone an					Ċ	•	•	•	Ċ	•	•		129 80	
Miscellaneou				-		•	•	•	:	•	•		90 56	
			waa c	дроп		•	•	•	•	•	•	•		\$90,791 8
ewer lines, la		•	•	•	•	٠	•	•	•	•	•	•	\$22,440 64	
Supplies and	exper	ases,	•	•	•	•	•	•	•	•	•	٠	2,018 93	24,459 5
Horses, vehicle	es and	stabl	le acc	ount									<u> </u>	7,217 4
feeting House													\$282 90	.,21. 1
Supplies and			_		·-•				•				225 00	
FFOD MIN	p	,	•	-	-	•	•	-	•	•	•	•		507 9
Total	_	_			_	-		_	_	_				\$188,271 9

GENE	General Character of Expenditures.  South Metropolitan System,												ar ending 31, 1907.
	South	Met	ropo	litan	Sy	stem					•		
Administration: —		and		tant							l	<b>\$3,288</b> 33	
Commissioners, sec	•				-			•	•	•	.	\$44 09	
Postage, printing, s Rent, telephone, he		-			_	_		•	•	•	- \	506 17	
• •	•	-	-			OT D	unun	ığ,	•	•	•	90 17	
Miscellaneous expe	•		•	•	•	•	•	•	•	•	٠,		\$4,428 70
General superintende											Ì		
Chief engineer and				•	•	•	•	•	•	•	•	\$4,484 63	
Postage, printing,		-			_	_		•	•	•	•	191 19	
Rent, telephone, he		_	-				uildi	ng,	•	•	•	1,501 38	
Miscellaneous expe	nses,	•	•	•	•	•	•	•	•	•	• [	501 84	6,678 5
Ward Street pumping	g static	on : —									ł		0,0,0
Labor,												\$17,719 34	
Coal,		• `										8,280 46	
Oil and waste, .							•					<b>888</b> 98	
Water,									٠.		.	1,318 80	
Packing,						•			•		.	845 18	
Repairs and renews	als,											<b>539</b> 88	
Telephone and offic	e supp	lies,	•									181 59	
Miscellaneous supp	lies ar	ıd ex	pens	es,								2,064 25	
Quincy pumping stat	ion:—	•											
Labor,			•				••	•				6,332 61	
Coal,	•						•		•	•		1,938 01	
Oil and waste, .	•			•		•	•		•	•	•	58 82	
Water,			•				• •	•	•	•	•	191 55	
Packing,			•		•	•		•				43 30	
Repairs and renews	als,			•		•	•	•			•	18 66	
Telephone and offic	e supp	olies,			•	•	•		•		.	76 10	
Miscellaneous supp	lies ar	ıd ex	pens	es,	•	•	•				•	491 81	
Nut Island screen-hor	use:								•				
Labor,	•	•	•		•		•	•	•	•		6,752 37	
Coal, · · ·		•	•	•	•	•	•	•	•	•		1,789 02	
Oil and waste, .		•	•	•		•	•	•	•	•	•	<b>85 64</b>	
Water,			•			•	•	•	•	•		<b>316 28</b>	
Packing,		•		•	•	•	•	•	•	•	.	8 82	
Repairs and renews	als,	•		•	•	•	•	•	•	•		127 53	
Telephone and offic	e supp	olies,	•	•	•	•	•	•	•	•	•	79 69	
Miscellaneous supp	lies aı	ıd ex	pens	ев,	•	•	•	•	•	•		601 69	50 105 9s
Camer Uman Jahr-											ļ	\$21,599 69	50,195 3
Sewer lines, labor,	•	•	•	•	•	•	•	•	•	•		1,538 18	
Supplies and expen	ıses,	•	•	•	•	•	•	•	•	•		1,000 18	23,137 8
City of Boston, for pr	ampin	gand	linte	rest					•		.		7,700 0
Horses, vehicles and					•								3,372 5
												-	40F E10 1
Total,	•	•	•	•	•	•	•	•	•	•	•		\$95,513 1

### (b) Receipts.

The receipts from the sales of property, from rents and from other sources, have been credited as follows:—

ACCOUNT.				For Year ending December 31, 1907.	From Beginning of Work to December 31, 1907.
North Metropolitan System, — construction, South Metropolitan System, — construction, North Metropolitan System, — maintenance, South Metropolitan System, — maintenance, Metropolitan Sewerage Loans Sinking Fund,	:	:	:	\$3,228 13 1,225 04 23 25 109 21	\$17,158 40 10,106 60 9,415 00 1,102 18 1,019 41
Totals,	•	·	•	\$4,585 68	<b>\$</b> 38,796 59

### (c) Assets.

The following is an abstract of the assets of the Sewerage Works, a complete schedule of which is kept on file in the office of the Board:—

Office furniture, fixtures and supplies; engineering and scientific instruments and supplies; horses, vehicles, field machinery, etc.; machinery, tools and other appliances and supplies; real estate connected with works not completed; completed works, including real estate connected therewith.

### (d) Liabilities.

There are liabilities as follows:—

There are other current bills unpaid, which have not yet been received.

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

Name.		Work.								
High-level Sewer: — National Contracting Co., E. W. Everson & Co., High-level Sewer Extension: Hugh Nawn Contracting Co. James Driscoll & Son, Timothy J. O'Connell, Chas G. Craib & Co., Timothy J. O'Connell, D. F. O'Connell, D. F. O'Connell, T. H. Gill & Co.,	 	Sect. Sect. Sect. Sect. Sect. Sect.	75, 81, i 82, i 82, i 82, i 83, i 83, i 84,	in pin pin pin pin pin pin pin pin pin p	part, part, part, part, part, part,			•	1,600 264 6,486 4,609 6,720 3,975	00 39 93 95 15 95 82
		,							\$33,683	13

<sup>1</sup> Damages claimed on account of the abandonment of the contract exceed this amount.

On the claims of the following it is impossible to state the amounts due for land and other damages, as no sums have been agreed upon, and suits are now pending in the courts for the determination of most of them:—

Boston Elevated Railway Company, Boston & Maine Railroad, Anna L. Dunican, Carrie S. Urquhart, N. Jefferson Urquhart, Edwin N. Urquhart, Richard Jones, James Doherty, Michael Niland, Michael Cashman, William H. Gibbons, Francis Normile, Crescent Land Company, George A. Goddard.

#### VIII. CONSUMPTION OF WATER.

The average daily quantity of water consumed by the cities and towns supplied by the Metropolitan Water Works was greater than the quantity so consumed in the previous year by 6,251,000 gallons, the daily quantity consumed being 125,071,000 gallons. The increase in the average daily consumption per inhabitant during the year was 3.8 gallons per day, the daily per capita consumption having reached the amount of 133.8 gallons. The above measurements are of the quantities of water as it is delivered from the various sources of supply.

There was an increase in the per capita daily consumption in 10 of the municipalities of the District, in 3 there was no change, and in 5 there was a decrease in the quantity. The large increase during the year is due in a great measure to the very cold weather which prevailed during the months of January and February, when water was allowed to run to waste in order to prevent the freezing of the water pipes. Another cause for the increase, especially in suburban districts, was the dry weather in July and August, when large quantities of water were used for the watering of gardens and lawns.

The most striking increase in the consumption is found in the town of Stoneham, where the daily per capita consumption increased from 69 gallons to 93 gallons, or 24 gallons per inhabitant. This increase is undoubtedly due to leakage in the local pipe system, and will cause a considerable increase in the water assessment of that town. There has been a large increase in the daily per capita consumption in the towns of Arlington and Belmont, largely on account of the use of water for gardening purposes. The increase in the per capita consumption in the city of Boston was from 151 gallons to

157 gallons per day, making a total increase of 5,471,000 gallons per day. The decrease in the per capita consumption occurred in the cities of Malden and Quincy, and in the towns of Lexington, Swampscott and Milton.

The large amount of water which is unnecessarily consumed or wasted is undoubtedly due to bad plumbing and the continued existence of leakages, as well as to the fact that in the coldest season the water is on many of the premises allowed to run continuously in order to prevent the freezing of pipes. The daily average consumption for the coldest week of the year was 154,500,000 gallons, or 30,364,900 gallons above the daily average for the year. The fact that the average consumption of water, as shown by the passage of the water through the pipes, between the hours of 1 and 4 in the morning, when but a very small quantity can be used for any legitimate or necessary purpose, amounts to an average daily rate per year of 84,000,000 gallons, and in the coldest weather reaches a point as high as at the rate of 110,000,000 gallons per day, or 88 per cent. of the entire consumption, proves not only that the water is constantly running to waste throughout the District,1 but also that this wastefulness occurs to a large extent on account of leakage of the local water pipes and bad plumbing in the houses.

The number of new meters which have been set during the past year in the cities and towns supplied by the Metropolitan Water Works was 4,334, — an increase of 77 over the total last year. The greater number of these meters were set in the cities of Melrose, Chelsea, Quincy and Somerville, and in the town of Swampscott, in which were installed a very large number in proportion to the population.

A comparison of the per capita consumption of water in cities and towns where meters are in general use with the consumption of other cities and towns where meters are not generally installed, proves conclusively the salutary effect of meters in reducing unnecessary consumption. In the four municipalities of Milton, Malden, Belmont and Watertown, where the services are generally metered, the daily average consumption in the month of February varied from 40 gallons to 61 gallons per inhabitant. In the four municipalities of Revere, Melrose, Winthrop and Chelsea, where the general conditions are similar but where the services are not generally metered,

<sup>1</sup> This is graphically illustrated by the accompanying diagram.

# DIAGRAM SHOWING AVERAGE RATE OF CONSUMPTION OF WATER IN THE METROPOLITAN DISTRICT IN 1907 DURING THE ENTIRE DAY

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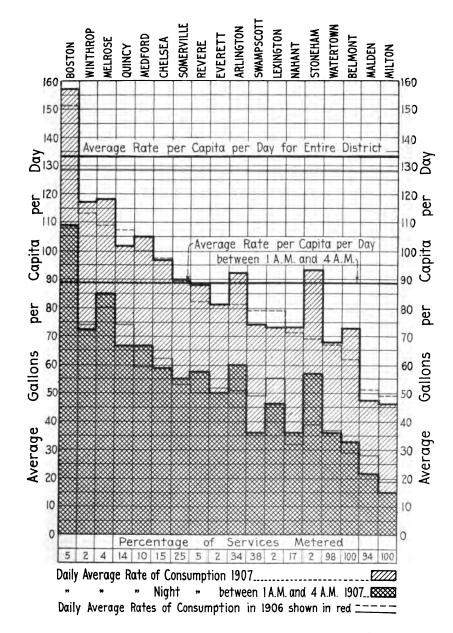
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# BETWEEN THE HOURS OF I AND 4 AT NIGHT





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the average daily consumption per inhabitant varied from 111 to 156 gallons in the same month.

The Legislature of last year passed an act providing that all municipalities taking their water supply from the Metropolitan Water Works should, after December 31, 1907, equip with water meters all services thereafter installed, and should annually equip with water meters 5 per cent. of the services which were then unmetered, and should thereafter charge each consumer in proportion to the amount of water used. Inasmuch as the Act goes into operation only with the current year, it has not affected the consumption of water.

The quantity of water used has now become the most important element in determining the amount of the assessment payable by each city and town in the Metropolitan District for the construction and maintenance of the Water Works, the sum assessed being based one-third upon the taxable valuation and two-thirds upon the consumption of water of each municipality. It is made an incentive not only for the District as a whole, but for each municipality, to check and to stop the unnecessary and wasteful consumption of water, which now reaches from one-third to one-half of the total amount supplied from the Water Works.

It has been demonstrated by the experience of the town of Milton and the city of Malden, where the consumption has been reduced to 46 and 47 gallons respectively for each inhabitant per day, as against the average consumption of more than 133 gallons for each inhabitant per day in the whole District, that the general introduction of meters, accompanied by the prompt prevention of leaks in street mains, will greatly reduce the consumption of water.

The want of rigorous inspection and the failure at once to check extensive leakages indicated has probably increased the assessment of the town of Stoneham for the current year by about 18 per cent.; while two years ago the discovery of leaks in street mains and their prompt repair reduced the consumption of water in that town by more than one-half.

The gradual installation of more meters in the city of Boston, the institution of stricter inspection, and the prompt suppression of defects and abuses, while entailing some additional present outlay, would go far towards decreasing assessments in that city, and postponing for years the necessity for seeking further sources of water supply and the construction of new large and expensive works. Great expenditures in the near future are inevitable if the present increasing rate of consumption in that city, now amounting daily to 157 gallons per inhabitant, shall continue.

The duty of preventing unnecessary and wasteful consumption of water is laid upon each municipality, not only for the protection of the financial interests of its own citizens, but in justice to the residents of those other districts of the Commonwealth whose lands must be taken and other properties affected in value and whose business interests must be impaired when the exigency arises for the further extension of the sources of water supply.

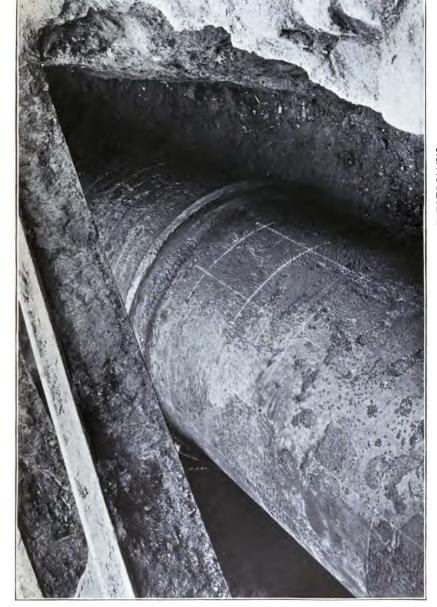
#### IX. ELECTROLYSIS.

Investigations have been made during the year for determining the general electrical action upon the pipe lines throughout the distribution system by the tracks of the electric street railways. In several places there was found indication of an increasing rate of injury resulting from the electric current. Many new gaging stations have been installed for the purpose of making more accurate determinations of the currents of electricity flowing upon the pipe lines.

Two additional insulating joints have also been placed, one in Chelsea and the other in Malden, not only for the purpose of ascertaining the direction and intensity of the electric currents upon the pipe lines, but also for controlling the flow of electricity.

At various points along the large water mains the pipes have been uncovered in order to ascertain the extent of the permanent injury which has been produced by electricity. The investigations show that the pitting and disintegration of the pipes from the electrical action has reached a serious extent, and the disintegrating process is continuing even in places where insulating joints and other devices have been applied for the purpose of arresting or overcoming the injury which is caused by the underground electric currents.

Measures will be taken not only for ascertaining the amount of the damage which has been caused, but also in order to determine the responsibility for the injury which arises from electrolysis, while all means which promise success will be adopted for the protection of the pipes.



42-INCH WATER PIPE IN CHELSEA PITTED BY ELECTROLYSIS.

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#### X. LEGISLATIVE ACTS OF THE YEAR 1907.

The Legislature of the year 1907 appropriated (chapter 201) a sum not exceeding \$143,000 for the cost of maintenance and operation of the North Metropolitan Sewerage System, and (chapter 200) a sum not exceeding \$105,000 for the cost of maintenance and operation of the South Metropolitan Sewerage System.

It was provided by chapter 165 that annual appropriations should thereafter be made for the maintenance and operation of the Metropolitan Water System, and that balances remaining on account of assessments in any one year should be taken into account in making the assessments of the succeeding year.

It is provided by chapter 238 that all sums of money paid by a city or town not belonging to the Metropolitan Water District, or by a water company in any such city or town, for water furnished to it by the Board, shall hereafter be applied to the Metropolitan Water Loan Sinking Fund, instead of being distributed to the cities and towns in the District, as before required by the Metropolitan Water Act.

Chapter 349 so amended the Metropolitan Water Act that the Board is empowered, on payment of a proper amount of money, in case of fire or other emergency, to furnish water to a city, town or water company within the Metropolitan Water District, as well as to a city, town or water company which is outside of the ten-mile limit prescribed for the Metropolitan Water District.

By chapter 524, cities, towns, districts or corporations which derive all or any part of their water supply from the Metropolitan Water Works or from sources used by or under the control of the Metropolitan Water District are required, after the year 1907, to equip with water meters all services thereafter installed for them, and annually thereafter to equip with meters in like manner 5 per cent. of the water services which were unmetered on December 31, 1907, and thereafter also to charge each consumer for water furnished in proportion to the amount of water used. The provisions of the act, however, do not apply to the water services used for fire purposes only. Provision is made for the necessary care, testing and replacing of meters, and it is required that proceedings for the enforcement of the provisions of the act shall be instituted and

prescribed by the Attorney-General, upon the complaint of any party in interest.

Chapter 269 extended the provisions relative to the hours of labor, so as to require that no laborer, workman or mechanic employed by or in behalf of the Commonwealth should be required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week, except in cases of extraordinary emergency; and it was further provided by chapter 577 that, except in cases of emergency or except at the request of the employé, it should not be lawful to require an employé engaged in the work of any industrial process to do such work on the Lord's Day, unless such employé should be allowed during the six days next ensuing twenty-four consecutive hours without labor.

## XI. RECOMMENDATIONS FOR ADDITIONAL WATER AND SEWERAGE LOANS.

The Board, in its abstract of the annual report to the Legislature at the beginning of the session of the year 1908, made the following statements and recommendations regarding additional water loans for necessary construction for the coming year and for the discharge of liabilities already accrued and existing:—

It appears from the foregoing financial statement that on December 1, 1907, the balance remaining on account of the Metropolitan Water Loan Fund, for the construction and acquisition of works, was \$193,903.93.

There are remaining unpaid certain reserves retained under contracts which have been completed, and there are still unsettled a considerable number of suits and claims arising under contracts for the construction of the Wachusett Dam and Reservoir, and suits for damages to lands and other properties and business in the Wachusett watershed. The Board is of the opinion that a sum considerably in excess of the balance of the Metropolitan Water Loan Fund remaining on hand December 1, 1907, will be required to pay for the existing indebtedness. It is anticipated that payment of by far the larger part of this indebtedness will be called for out of the present balance or coming appropriation, and it is quite possible that the entire amount will be payable during the current year, or before an appropriation for the next year would become available.

There being a considerable balance on hand at the close of the previous fiscal year, the Legislature of last year made no appropriation for the construction and acquisition of works.

The operations of the Board during the past year have been confined to the completion of work already begun or whose construction had been provided

for. The expenditures have been principally made for small additions required for the completion of the Wachusett Dam; for the repair and improvement of the North Dike; toward the completion and equipment of the Arlington pumping station, and improvements at the Chestnut Hill pumping station; for work upon the bed of the Wachusett Reservoir, necessitated by the gradual filling of the reservoir with water; and in the settlement of existing claims and suits for damages. Only such work as seemed to be urgently demanded under the plans originally laid out has been done during the past year for the improvement of the watershed and for preventing the pollution of the water supply.

There are important works whose necessity was contemplated to arise under the original scheme adopted by the Water Act of 1895, which were to be undertaken in the second ten years after the passage of the Water Act of 1895. It is the purpose of the Board to defer the construction of such new works until they are urgently called for by the exigencies of the water supply.

There are, however, two objects for which it seems necessary for the Legislature to make provision during the coming year.

The original Water Act provided that the Board might use the fall of water at any dam under its charge, and might produce and transmit power or electricity and sell the same. The gate-house at the base of the Wachusett Dam has been so constructed that a power plant may be installed in it. The reservoir is now rapidly filling with water, and the time will soon come when it will be possible to utilize the power which can be generated at the dam.

In none of the loans which have been authorized has any provision been made for the construction of the power plant; and it would seem to be proper, if not necessary, that money which may be required for such a purpose—for the carrying on of a business, and not for the purpose of a water supply—should be specifically appropriated, and special authority be given for the expenditure of the required amount from the water loan fund.

Preliminary estimates have been made of the amount which would be required for a plant for the production of power at the dam; and the Board is now engaged in the investigation of the various questions arising as to the production of power, and the means and opportunity for its disposal when manufactured. Whether power can be so produced of a sufficiently marketable character, and can be disposed of at prices sufficient to ensure the Commonwealth against loss in the operation, is in part dependent upon the valuation of the power plant for local taxation.

If the Board reaches the conclusion that favorable arrangements can be made for the construction of the plant and its profitable operation, legislation will be required to authorize the Board to enter into such arrangements, and also a proper provision will have to be made for an additional water loan to defray the cost of construction.

There is a necessity that speedy action shall be taken for increasing the pressure of the water supplied to the low district of the city of Boston. The rapid increase in the water consumption in this district has been such as to make the pressure inadequate for many of the higher buildings, and to

cause possible danger in case of fire, as well as considerable inconvenience and annoyance at times to water takers. The Board has reached the conclusion that the feasible remedy for the troubles which exist lies in the construction of a new water main from the Chestnut Hill Reservoir, through the intervening portion of the town of Brookline, to the boundary line of the city of Boston.

No new main for the supply of that city has been laid since a date many years previous to the taking over of the Boston Water Works by the Metropolitan Water Board.

No other large work of construction is anticipated as required during the coming year. It is deemed necessary, however, by the Board to continue the work originally called for by the report of the State Board of Health, and which has been gradually carried out, of removing the more threatening sources of pollution, and adopting measures for the purification of the water supplied to the District. This work is carried on by the ditching of noxious swamps; the cleaning of filthy ponds and streams; the turning of polluting house and farm drainage and brooks and streams into cesspools and filterbeds; and, in occasional instances, the acquiring possession of properties which are a permanent menace to the water supply. Small additions are required at the Wachusett Dam, and some further work will be required for the removal of soil made necessary by the filling of the Wachusett Reservoir.

The Arlington pumping station has been in process of construction during the year, and its equipment will be completed early in the current year.

The Board accordingly recommends that authority may be given for additional water loans, to be issued from time to time as may be required for the above purposes, to a total amount not exceeding \$450,000. It is estimated that this amount will be required for expenditures as follows:—

For power pla	ant at	wa.	chuse	ett da	m,									\$115,000	00
For concrete	walls	and	tile f	loor a	t Wa	chus	ett d	am,						7,000	00
For new 48-in	ich m	ain f	rom	Chest	nut I	Iill r	eser	voir t	o Bos	ton l	ine,			200,000	00
For minor ad	dition	as to	the \	Wach	usett	dam					•			3,700	00
For work at	the W	acht	sett	reser	voir,		•							2,000	00
For completi	on of	the A	Arlin	gton	pumr	ing	tatio	n and	i its	equip	ment	t		14,500	00
For the const													ary	•	
on the Wac	huse	tt wa	tersh	ed,					٠.				٠.	15,000	00
For engineer	ing ar	nd ad	mini	strati	on ex	pens	es ch	argea	ble t	o con	struc	tion,		27,500	00
For settlemen														•	
contracts,	•		•		•		•		•	•	•	•	•	260,000	00
Total,														\$644,700	00
Balance rema	ining	on h	and	Dece	mber	1, 19	07,		•				•	193,903	93
														\$450,796	07

It is pertinent to add that of the expenditures, which it is above recommended that the Board shall have authority to make, a considerable portion is for the construction of works which will yield a return, and lessen rather than increase the assessments that the Metropolitan District will be called upon to pay. The other expenditures, other than those required for the

payment of existing indebtedness, are mostly made necessary on account of the increasing consumption of water, for which the various municipalities in the District receive a return by means of increased collections of water rates.

According to the report of the Treasurer of the Commonwealth, while the assessments for the payment not only of the current expenses of maintenance and interest on the Commonwealth's indebtedness, but also of the sums called for by the sinking fund to extinguish the debt in a series of years, and which are entirely paid by the municipalities of the District, amounted, for the year 1906, to \$2,262,657.20, the sums collected by the various cities and towns in water rates amounted to \$3,568,184.83. It is believed that the excess of receipts over assessments is more than the amount of all the expenditures annually incurred in the distribution of water; that in many of the municipalities there is a current yearly balance of municipal revenue over expenditure in the municipal water supply accounts; and that the quality of the water has been much improved, while in no case have the rates payable by the individual water takers been increased, by the introduction of the Metropolitan Water Supply System.

The Board also recommended that authority be given for additional sewerage loans for the North Metropolitan System, and made the following statements relative to the necessity for such loans:—

The Board has for a considerable period been desirous of constructing a building or group of small buildings near the East Boston pumping station, to be used as a stable and locker and for the general purposes of the North Metropolitan Sewerage System. The buildings now used for these purposes are temporary structures, put up to supply the needs for the time being until permanent buildings could be erected. Permanent construction has been deferred on account of questions arising as to the proposed location of the buildings. The Board has reached the conclusion that they should be built upon the present location, and that the work of construction ought now to be begun. The balance remaining unexpended on the North Metropolitan Sewerage Loan Fund (\$31,995.97) is more than sufficient to defray the cost of the work; but, inasmuch as this object was not specified when the loans, from which a balance remains, were authorized, the Board desires authority from the Legislature to use such portion of the balance as is necessary for this purpose.

The Board is obliged to call the attention of the Legislature to the necessity of providing in the near future additional sewage pumping facilities for the North Metropolitan District. The pumping plants at East Boston and Deer Island are already becoming inadequate for the work which they are called upon to do.

The Metropolitan Sewerage Commission, at the time that these plants were built and installed, gave the ultimate quantities of sewage for which the plants were designed to provide. It was expected that these quantities would not be reached for a long period to come. It, however, appears that at both

the East Boston and Deer Island stations the quantities assumed as the maximum capacities of the plants have already been attained, and that the average quantities which they were expected to pump have been surpassed in the wetter months of the year. These results have naturally arisen from the greater increase of population and the far greater consumption of water than was anticipated by the former Sewerage Commission. During prolonged periods all the pumps at these stations must be kept in continuous operation, and there is no reserve in case of breakdown or other accident. Several of the boilers also have been in constant service for the eighteen years which have elapsed since their construction, and have about reached the time limit of endurance and safety.

The amount necessary for the additions to these plants is considerable, as the additions involve not only a new pumping engine in each station and new boilers, but also enlargements of the engine houses and additional coal-storage rooms. Three or four years will be required to install and equip the additional plants, and the Board is of the opinion that the beginning of the work cannot safely be deferred for another year. The expenditures necessary would extend over a period of at least three years.

The Board recommends that authority be given for additional sewerage loans for the North Metropolitan System, to be issued from time to time as may be required for these purposes, to an amount not exceeding \$485,000. It is estimated that this amount will be required for expenditure as follows:—

For stable and locker buildi	ings s	t Eas	st Bo	ston,	•					\$15,000 00
For East Boston pumping st	tation	a exte	ensio	a : —	•					
Expenditures in 1908,									\$80,000	
Expenditures in 1909,									123,000	
Expenditures in 1910,									77,000	
• ,										280,000 00
For Deer Island pumping st	ation	exte	nsior	ı: <b>—</b>						•
Expenditures in 1908,									\$45,000	
Expenditures in 1909,									103,000	
Expenditures in 1910,		•							72,000	
										.220,000 00
										\$515,000 00
Balance on hand Dece	embe	r 1, 1	907,	•	•	•	•	•		31,995 97
										<b>\$</b> 483,004 03

The work of constructing the extension of the High-level Sewer of the South Metropolitan System has been making successful progress during the past year, and will approach completion during the current year. It is believed that the balance now on hand for that system will be sufficient to meet all the expenses for construction during the year.



STEEL FORMS FOR PLACING CONCRETE MASONRY LINING IN TUNNEL-HIGH LEVEL SEWER EXTENSION.



• . .

#### XII. SEWERAGE AND WATER ASSESSMENTS.

The sums necessary to meet the expenses of the maintenance and operation of the Sewerage Works, the payments of interest on the bond indebtedness, and the requirements of the sinking funds, have but gradually changed from year to year. The assessments actually levied upon the municipalities have, however, for certain reasons, greatly varied in recent years.

Prior to the year 1907 premiums received from the sale of bonds were applied to the reduction of the assessments. In one year, 1903, for instance, the premiums from bond sales reduced the assessments in the South Metropolitan Sewerage District to three-fifths of what they otherwise would have been. The Statute of 1906, chapter 338, however, provided that premiums thereafter so received should be paid into the sinking fund and not be applied to the reduction of the yearly assessments.

It was recently determined by the Treasurer of the Commonwealth to be desirable to have the State books of accounts dealing with the various Metropolitan districts examined in order "to make sure that no errors had occurred in the accounting between the State and the districts up to the present time." A careful examination of all the accounts with the Treasurer's department relating to the districts was accordingly made, and, in compliance with the report of the accountant and his recommendations, it was found necessary to make The Treasurer accordcertain adjustments in the various funds. ingly caused additions to be made to some funds and reductions from others. Under these adjustments by the Treasurer the assessments of the North Metropolitan Sewerage District for the year 1907 were reduced by \$114,446.52, or about 32 per cent., from what they otherwise would have been; while in the same way the assessments of the South Metropolitan District were increased by \$91,997.34, or more than 22 per cent., above what they otherwise would have been for that year. These exceptional variations in the assessments for the year 1907 must necessarily be taken into account by the cities and towns in the two districts in making up their estimates of the amount of the assessment which will be levied for the current year in their respective municipalities.

Sums received from sales of bonds and also sums paid by municipalities on admission into the Metropolitan Water District have in a similar manner been applied to reducing the amounts of the assessments made upon the cities and towns in the Water District for the years of their receipt. These also, in accordance with the Statute of 1906, will hereafter be paid into the sinking fund.

The adjustments of accounts made by the Treasurer, above referred to, caused a deduction in the total assessments upon the cities and towns in the Metropolitan Water District of \$75,509.80 from the amount which otherwise would have been payable to meet the requirements of maintenance, interest and sinking funds. This exceptional reduction in the assessments for the year 1907 will also have to be considered by the cities and towns in the Water District when estimates are made of the sums which will be required for the current year.

#### XIII. FUTURE WORK.

The Board has estimated that the total amount of \$684,000 will be required during the coming year for the maintenance and operation of the various works for water supply and distribution of water to the cities and towns of the Metropolitan Water District, and of the works constructed for the collection and disposal of the sewage of the municipalities of the Metropolitan Sewerage District.

There was comparatively little additional construction in connection with the Water Works carried on during the past year, although considerable was required to be done in the finishing up of the Wachusett Dam and Reservoir and other works which had been begun, and in meeting the most pressing demands which arose for the sanitary improvements upon the watersheds and for the protection of various sources of water supply against pollution.

There are still important works remaining to be built under the requirements placed upon the Board by the Metropolitan Water Acts, which, in the original scheme of the State Board of Health, were for the most part deemed necessary to be supplied in the second period of ten years succeeding the year 1895. There are also additional requirements made necessary by the growth of districts or by special local circumstances. It has been the policy of the Board to defer the beginning of the construction of such works until the necessity for them becomes demonstrated and urgent.

It is at the same time made the duty of the Board to represent the existing conditions, and to ask for the necessary appropriations required to supply the needs and to "provide a sufficient supply of pure water" for the various cities and towns constituting the Metropolitan Water District and for the inhabitants thereof.

The Board, in its abstract of the Annual Report, which was laid before the Legislature on the third Wednesday in January, enumerated the various objects of construction for which it deemed necessary to make provision during the current year. These, as set forth upon a preceding page, included the construction of a new 48-inch main from Chestnut Hill Reservoir to the Boston line, more especially for the relief of the low-service district of the city of Boston. The Board also stated that it was believed that the time had come when it should take measures to utilize the opportunities for generating power at the Wachusett Dam, as contemplated by the Metropolitan Water Act.

If the present rate of water consumption continues unchecked for one or two years longer, it will undoubtedly be necessary to proceed to lay a second 48-inch main from the terminus of the Weston Aqueduct into the Metropolitan District, and to make extensive additions to the pumping plant at Chestnut Hill. In like manner further pipe lines will be absolutely required in the northern part of the Metropolitan District.

It is hoped that the Board will be able during the coming year to effect a settlement, through the courts or otherwise, of the various suits and claims brought in connection with the Water Works for damages still unadjusted on account of the construction of the Wachusett Dam and Reservoir, and on account of alleged depreciation in value of property not taken and injuries caused by the operations of the Board to estates and to established business in towns where the reservoir is located.

It is expected that the construction of the extension of the Highlevel Sewer in the South Metropolitan Sewerage District will approach completion during the coming year. The further extension of the sewer through the city of Newton will probably not be required for a few years to come, unless additions are made to the District.

The construction of the North Metropolitan System was begun about nineteen years ago, and, on account of the large increase in the population and business of the territory constituting the District and the still greater increase in the amount of sewage which must be received, it is becoming necessary to make considerable enlargements and extensions and to renew some of the works which have reached the limit of their capacity or period of safe operation. The Board has accordingly in its recommendations to the Legislature asked for authority to make additions to the East Boston and Deer Island sewerage pumping stations, and to install and equip additional plants in them. The situation at these pumping stations seems to call most urgently for relief.

There are other parts of the system to which relief must be extended in a comparatively short period of time. This is particularly the case with the portion of the Mystic valley main sewer, which receives the sewage of the city of Woburn and town of Winchester. This main sewer has so nearly reached the limit of its capacity that it is inadequate in times of heavy rains to dispose of all the contents of the local sewers, and as a result considerable quantities of the sewage and manufacturing wastes diluted with storm water overflow in different localities through the manholes. The situation is such that a new main sewer in this district will probably soon be called for.

The detailed reports of the Chief Engineer of the Water Works and of the Chief Engineer of the Sewerage Works, with various tables and statistics, are herewith presented.

Respectfully submitted,

HENRY H. SPRAGUE. HENRY P. WALCOTT. JAMES A. BAILEY, JR.

Boston, February 26, 1908.

# REPORT OF CHIEF ENGINEER OF WATER WORKS.

To the Metropolitan Water and Sewerage Board.

GENTLEMEN: — The following is a report of the operations of the Engineering Department of the Metropolitan Water Works for the year ending December 31, 1907.

#### ORGANIZATION.

The principal changes in the personnel during the year have been the resignation of Frederic P. Stearns from the office of Chief Engineer, which occurred on February 1, and of Alexander E. Kastl, Division Engineer in charge of the Wachusett Department, on August 20.

Mr. Stearns, with Joseph P. Davis and Hiram F. Mills, have been retained to act as consulting engineers upon important questions

The principal assistants employed under the direction of the Chief Engineer at the close of the year were as follows:—

Elliot R. B. Allardice, . Superintendent, Wachusett Department. Charles E. Haberstroh, . Superintendent, Sudbury Department.

George E. Wilde, . . . Superintendent, Pipe Lines and Reservoirs, Distribution Department.

Arthur E. O'Neil, . . Superintendent, Pumping Stations, Distribution Department.

William E. Foss, . . . . Division Engineer.

Alfred O. Doane, . . . Division Engineer.

Benjamin F. Hancox, . Assistant in Charge of Drafting Department.

Samuel E. Killam, . . Office Assistant. Arthur W. Walker, . . Biologist.

William W. Locke, . . Sanitary Inspector.

At the beginning of the year the engineering force, including those engaged upon both the construction and maintenance of the works, numbered 48, and at the end of the year 45.

There has also been a maintenance force, exclusive of the engineers above mentioned, averaging 234, employed in the operation of the several pumping stations and in connection with the maintenance of the reservoirs, aqueducts, pipe lines and other work.

Special gangs of men have been employed in repairing and strengthening the North Dike, in constructing ditches for the drainage of swamps in Holden and Princeton, and in cleaning weeds from the bottom of the unfilled portion of the Wachusett Reservoir. The number of men employed on construction, exclusive of those employed by contractors, has averaged 93.

# ARRANGEMENT OF REPORT.

The arrangement which has been adopted in the reports of previous years is followed in continuing this report, and the work charged to the construction account is kept separate from that charged to the maintenance account; but, as the work of construction and maintenance is supervised by the same principal engineers, and in very many cases the assistants are engaged upon both classes of work, it is not feasible to make a complete separation.

#### CONSTRUCTION.

#### GENERAL STATEMENT.

The principal work of construction in progress during the year has been in connection with the repairs and reinforcement of the North Dike, the construction of ditches for the drainage of swamps on the Wachusett watershed in Holden and Princeton, the installation of electric lighting, pumping and hoisting machinery at the Wachusett Dam, the final cleaning of the bottom of the Wachusett Reservoir between elevation 375 and high-water mark, the completion of the Arlington pumping station, including the installing of pumping engines, boilers and piping, and the installation of an additional boiler at the high-service pumping station at Chestnut Hill.

A detailed statement of the contracts made and pending during the year is given in Appendix No. 1. The following statement gives a summary of all the contracts charged to construction from the beginning of the work to the end of the year 1907:—

PORTION OF WORK.	Number of Contracts.	Approximate Amount.
Wachusett Reservoir,	38	\$3,057,395 87
Wachusett Dam,	17	1,845,221 91
Relocation Central Massachusetts Railroad,	6	516,327 67
Wachusett Aqueduct and Clinton sewerage, Sudbury Reservoir, the portions of contracts not performed at the time they were assumed from the	19	1,516,259 67
city of Boston, . Sudbury Department, reservoir, filter-beds, pipe lines and improvement of Lake Cochituate, Metropolitan	11	583,220 54
Water Works contracts	22	956,508 17
Weston Aqueduct and Reservoir, Distribution Department, including pipes, valves, and	26	2,212,403 31
special castings purchased for other departments, .	165	4,579,252 75
	304	<b>\$15,266,589</b> 89

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# WACHUSETT RESERVOIR AND DAM.

#### North Dike.

On the afternoon of April 11 an earth slide occurred at the North Dike of the Wachusett Reservoir, at which time 60,800 cubic yards of material from a section of the dike about 700 feet long slid into the reservoir. The slide occurred at the highest portion of the dike, where the artificial embankment was about 80 feet high and 1,930 feet thick at the base. The depth of the water in the reservoir in front of the embankment at the time of the slide was about 42 feet.

The dike, at the point where the slide occurred, had been constructed with a water-tight core 100 feet wide, the nearer edge of which was located about 50 feet back of high-water line. This core was composed of soil stripped from the reservoir, deposited in 6-inch layers and rolled, and was protected on the reservoir side by an embankment of sand and gravel. The embankment was faced with heavy riprap, stones screened from gravel, and coarse gravel; the heavy riprap extending from 5 feet above to 12 feet below high-water mark, the stones from the foot of the riprap for a further depth of about 12 feet, and the coarse gravel below to the foot of the slope. The

material used in the portion of the embankment between the water-tight core and the reservoir contained a large proportion of very fine sand which was excavated from the cut-off trench. This material was not consolidated when deposited in the embankment, and appearances indicate that when saturated by the rising water in the reservoir it would not stand on a slope of 2 horizontal to 1 vertical, which was the slope upon which the face of the embankment was constructed.

When the slide occurred the heavy stone riprap, which was about 10 feet in thickness, was carried from 150 to 250 feet by the momentum of the moving mass, and some of the sand and gravel was carried to a distance of 325 feet from the foot of the embankment.

Immediately after the slide occurred investigations were begun to determine the probable cause of the slide and the best method of making repairs to prevent further trouble. After obtaining the advice of the consulting engineers it was decided not only to repair the damage done by the slide, but also to reinforce the dike at this and other points.

The work as carried out consisted in reinforcing the dike wherever the artificial embankment extended below the foot of the riprap. This condition existed not only for a distance of about 1,000 feet, where the slide took place, but also at five points on the westerly portion of the dike, aggregating 1,560 feet. The embankment was reinforced by flattening the slope below the foot of the riprap from a slope of about 2 horizontal to 1 vertical, with which it was originally built, to a slope of 4 to 1, and at some points the slope was made 5 to 1. As it was not convenient to deposit the filling on this slope below the level of the water in the reservoir, a berm 30 feet wide was constructed about 2 feet above the water, and the filling allowed to take its natural slope, which was about 2 horizontal to 1 vertical. It is expected that the action of the waves will in time flatten this outer slope so that it will assume an approximately uniform slope of 4 to 1.

At the point near the centre of the slide, where the water in front of the embankment had been deepest, the berm was carried out for an additional width of 25 feet.

Above elevation 384 the embankment has been restored with practically the original section. Over the gravel slopes between elevations 375 and 400 there has been placed a layer of quarry chips 12

inches in thickness, and above elevation 384 the slope has been further protected by heavy riprap. There has also been placed at the toe of the heavy riprap, for an aggregate length of 6,500 feet, a section of quarry chips or field cobble stones 2 feet high at the foot of the riprap and having a slope of about 4 horizontal to 1 vertical. This was done for the purpose of preventing the washing out of the gravel from under the riprap by the action of the waves. With the exception of the placing of the heavy riprap all of this work has been done by a day-labor force under the immediate direction of the Superintendent of the Wachusett Department.

On April 29 a force of 50 men and 20 horses and carts began refilling the space made by the slide with gravel obtained near by, within the limits of the reservoir. The gravel was first deposited so as to restore and reinforce the embankment to a height about 2 feet above the level of the water in the reservoir, or to elevation 375, and was thoroughly consolidated by being deposited in the water, and also by the constant travel of the carts.

After this portion of the work was completed, the embankment, having a slope of 4 horizontal to 1 vertical, was constructed to elevation 383, and above this elevation practically the original section of the dike was replaced.

In placing the gravel above elevation 375 it was deposited in about 12-inch layers, and was consolidated by the traffic of the carts and by being saturated with water pumped upon it from the reservoir by means of a 6-inch by 4-inch by 6-inch Worthington duplex steam pump, which was kept in operation both day and night for about one month until the embankment reached elevation 400, or 5 feet above the level of the full reservoir.

Especial care was taken to excavate from the face of the slide all loose or cracked portions of the embankment, and jets of water were forced into the fill along the line between the new and old work for the purpose of securing a complete bond of the materials.

The day-labor work was completed on October 30. The maximum force employed was 137 men and 105 horses, and the average force was 114 men and 69 horses.

The quantities of materials handled and the cost of the work done by day labor, including the cost of building construction roads, pumping water for puddling embankment and of supplies and miscellaneous expenses, were as follows:—

	-			•				Cubic Yards.	Cost per Cubic Yard.	Total Cost.
Earth excavation :	_									
Bank gravel, .								105,870	<b>\$0.3295</b>	\$34,895 04
Sand or fine grav	el,							6,118	0.2605	1,593 61
Loam,				•				2,080	0.2920	607 31
Rock excavation:	-									
Quarry chips, .								5,469	1.094	5,981 33
Field cobbles, .								1,026	0.577	591 80
Totals,	•	•	•	•	•	•		120,563	-	\$48,669 09

On September 6 a contract was made with the Hugh Nawn Contracting Company of Boston to place about 7,000 cubic yards of riprap on the reservoir side of the repaired portion of the dike. The work of installing the plant was begun on September 24, placing of the riprap on October 17, and on December 31 only about 600 cubic yards remained to be placed.

The rock was secured from a quarry on land belonging to the Commonwealth, lying between the Wachusett Reservoir and the Central Massachusetts Railroad, about 900 feet west of the Wachusett Dam. At the quarry the rock was placed in skips, which were placed on flat cars and hauled about 2,800 feet by a small locomotive, and finally placed by means of a derrick. The maximum force employed was 49 men, during the week ending November 23, and the average force was 33 men. The cost of the work done under this contract to the close of the year was \$12,880. The total cost of the completed work will be about \$58,000.

# Soil Stripping.

On the southerly shore of the Wachusett Reservoir near Sawyer's Mills, near Boylston Center, near Pine Hill and near the West Boylston depot, and on the northerly shore near Sawyer's Mills and French Hill, additional clearing, grubbing and removal of soil have been done back of places where the steep banks, acted upon by the rising water, frost and rain, have caved away and retreated nearly to the limit of the original soil stripping, or of the additional soil stripping done last year. The soil has been stripped along an aggregate length of about 4,600 feet of shore line for a width of from 10 to 40 feet, the aggregate area being 2.1 acres.

# Cleaning of the Reservoir Bottom.

Between September 1 and December 3 the final cleaning of the reservoir bottom was done between elevation 375 and the limits of stripping, or 3 feet above high water. Over the area between elevations 375 and 385 the greater part of the ground was harrowed with spring-tooth harrows, and the weeds, grass and bushes, together with the roots, were afterwards raked and burned; while over the remaining portion of this area, where the harrows could not be used on account of the ground being rocky, steep or wet, the weeds, grass and bushes were mowed close to the ground, and afterwards raked and There was cleaned in this manner a total of 785 acres of ground, at a cost of \$5,426, or an average cost of \$6.91 per acre. This cost per acre is \$1.04 less than that of last year, notwithstanding the higher rates of wages paid, due to the fact that the entire area was cleaned last year in a similar manner. At the time this portion of the work was finished the waters in the reservoir were rising rapidly, and it was decided to continue the cleaning to the limits of stripping. So long as the weather conditions were favorable the methods pursued were as described above, but after freezing set in the weeds, grass and bushes were moved close to the ground, the ground was thoroughly raked over with heavy iron road rakes and the débris was burned or removed from within the reservoir The area treated in this manner was 345 acres, at a cost of \$2,129, making the average cost \$6.17 per acre. The entire area cleaned during the year was 1,130 acres, at a cost of \$7,555, or \$6.68 per acre.

# Shore Protection.

On the northwesterly shore of the reservoir, just above the north-westerly end of the waste-weir of the dam, the slope of the ground for a distance of 165 feet being steeper than the natural slope of the material was protected with a covering of bank gravel during 1906, and in order to further protect this stretch of shore from the wave action to which it is exposed, riprap, having a thickness of about 3 feet, has been placed outside the gravel.

#### Work at Wachusett Dam.

A lighting, pumping and hoisting plant for use at the dam, and operated by water power, was installed between January 22 and April 3. The machinery consists of a 9-inch turbine, directly connected with a 22½-kilowatt generator, which are used in operating a 10 horse-power motor attached to a 6-inch submerged centrifugal pump, and a 6 horse-power motor connected with a crane for handling stop-planks and screens in the upper gate-chamber. The turbine was furnished and installed by the Holyoke Machine Company of Worcester; the generator and motors were built by the Stanley Electric Company, furnished by the Frank Ridlon Company and installed by the Plummer Electric Company, who also did all the wiring, etc., necessary for the complete installation of the plant.

Aside from the skilled labor furnished by the Holyoke Machine Company and the Plummer Electric Company, the work was done by the regular maintenance force.

In addition to and in connection with the above work a concrete floor has been built in the exciter room, and the wooden floor of the main room has been raised to its permanent level.

A 4-inch Venturi meter has been set and connected with a manometer tube for measuring and recording such quantities of water furnished the Lancaster Mills as are too small to be measured through the 12-inch Venturi meter.

The 10-inch Venturi meter which measures the water flowing into the Lancaster-Mills Pond has been fitted with a manometer tube for indicating the flow.

Two iron ladders, made by the New England Bolt and Steel Company, one 29 feet 2 inches long and the other 18 feet ½ inch long, have been placed in the drain well and well No. 4 of the lower gate-chamber.

For the purpose of preventing percolation of water through the masonry of the dam, expansion cracks in the joints of the ashlar facing of the up-stream face of the dam were filled and painted with Portland cement mortar, between elevations 367.50 and 380, during very cold weather in February, when the cracks were the largest, and continued to elevation 384 in November, in order to keep the work above the rapidly rising waters in the reservoir.

### Miscellaneous.

During the year 49 acres of land about the margins of the Wachusett Reservoir in the town of West Boylston has been graded and seeded. About 35 acres of this land was a shallow flowage fill in Oakdale, and on the remainder there were old cellar holes which required considerable grading. At the gravel pit in Clinton, from which sand and gravel were obtained for use in constructing the Wachusett Dam, such grading has been done as was necessary to smooth the slopes and fill depressions so as to prepare the ground for the planting of pine trees.

The houses on the properties formerly owned by Aime Gregoire and Delia A. DeFoe in Boylston, and by Henry O. Sawyer in West Boylston, have been demolished.

# IMPROVEMENT OF WACHUSETT WATERSHED.

# Drainage of Swamps.

The construction of ditches for the drainage of swamps tributary to the Wachusett Reservoir, which was suspended on December 1, 1906, was resumed on May 22, 1907, in the swamp on Governor Brook, above the junction of Trout and Governor brooks in the towns of Holden and Princeton.

The methods of carrying on the work, types of ditches built and permits received from the owners of the land have been substantially the same as described in the annual reports of January 1, 1899, and January 1, 1907.

The swamp on Governor Brook has an area of 220 acres, which includes 4 acres of what was previously considered a separate swamp, but which is virtually a part of this one, and the area of the watershed above its outlet is about 1,625 acres. Work in this swamp was completed on November 23.

The depth of the ditches constructed is generally  $1\frac{1}{2}$  to 3 feet, and the slope paving is carried to a height of 1 to 2 feet above the bottom. In connection with this work a stone highway culvert  $4\frac{1}{2}$  feet wide by  $4\frac{1}{2}$  feet high was built across an abandoned but not discontinued highway, about 1,000 feet east of the highway leading from Quinepoxet to East Princeton. The old culvert at this highway was too high for the grade of the new ditch and insufficient in capacity. The work has been done by a day-labor force.

The maximum force employed was 46 men and 4 horses during the week ending August 24, and the average force was 35 men and 1 horse.

The amount of work done during the year was as follows: —

Ditches with boar Ditches with stone Ditches without b	e pa	ving	on be	otto	m and	side	es (lir	iear i	eet),	•	•		19,864 335 2,865
Total length	of d	itche	lin (	ear	feet),	•					•		23,064
Farm crossings, Watering places, 4½-foot by 4½-foot Wire guard fence	stoņ	ne hig	hwa	y cu	ılvert,				•	•	•	•	12 2 1 2,025

The total amount of work done in this swamp, including the work done in 1906, was as follows:—

Ditches with board bottom and paving on sides (linear feet), Ditches with stone paving on bottom and sides (linear feet), Ditches without board bottom or paving (linear feet),		•	•	23,959 447 3,255
Total length of ditches (linear feet),				27,661
Brook improved (linear feet),		٠.	• •	120
Farm crossings,				17
TTT 4 * 1		•		5
2-foot by 2-foot concrete highway culvert,			•	1
4½-foot by 4½ foot stone highway culvert,		•		1
Wire guard fences (linear feet),	•		•	2,025

The total length of ditches constructed during the year was 23,064 feet, equal to 4.37 miles, at a cost, exclusive of engineering, of \$10,647, or \$0.462 per foot. This cost is slightly lower than last year, although higher rates of wages were paid, and the cost of cleaning up on both sides of the ditches built both last year and this, is included. This result may be attributed largely to having a foreman and laborers who were experienced in this line of work, and also to the dry condition of the swamp, due to the small rainfall during the greater part of the working season. The cost of the work includes the cost of building the culvert, farm crossings, watering places and wire guard fences.

Since November 23, 1899, when the drainage of swamps in the Wachusett watershed was commenced, there have been constructed 57,812 linear feet of ditches, equal to 10.95 miles.

# Sterling Filter-beds.

Work under A. McKenzie & Company's contract for the construction of four filter-beds, to be used for filtering the water of a small brook, which has its head waters in the village of Sterling Center, was resumed on April 1 and completed on May 23, 1907.

The location, description and proposed method of operating this plant were fully described in last year's report.

The following table gives the quantities of work done to December 31, 1906, during 1907, and the total amount of work done to the end of the contract, based on the final estimate:—

						To December 31, 1906.	During 1907.	Total.
Earth excavation (cubic yards), .						25,270	3,642	28,912
Concrete masonry (cubic yards), .		•	•			41	15.6	56.6
Dry rubble-stone masonry and pavin	g (cı	ıbic y	arde	1),	•	166	69	235
18-inch vitrified pipe (linear feet), .						132	6.7	138.7
15-inch vitrified pipe (linear feet), .	<i>,</i> •					269.4	0	269.4
12-inch vitrified pipe (linear feet), .	•					145	812.4	457.4
8-inch vitrified pipe (linear feet), .						856.5	0	856.5
6-inch vitrified pipe (linear feet), .						880	88.0	918.0

In addition to the above work the contractors built about 1,960 feet of wire truss fencing on the property lines; built a concrete watering trough 3 feet wide by 7 feet long by 2 feet deep for William Kingsbury's cattle, and laid 55 feet of 1-inch water pipe from the main inlet ditch to the trough.

The maximum force employed by the contractor was 29 men and 7 horses, during the week ending April 20, and the average force was 22 men and 4 horses.

During the extremely dry season last summer it was found that the small amount of water coming from the ditches above the filter-beds seeped through the paving in the bottom of the inlet ditch before it reached the inlet to Kingsbury's watering trough, so, in order to utilize what water there was in the ditch, the joints in the bottom of the paving were filled with Portland cement mortar from the end of the board bottom swamp drainage ditch to the inlet pipe to the trough, a distance of 380 feet.

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A small wooden building 3 feet by 13 feet has been built fir storage of tools and sonvenience of the keeper.

The water dowing in the brook was turned on to the beds on . 23, and the entire flow of the brook has been filtered since that (

# Sering Junction Füter-beds.

Immediately north of the main highway leading through Methodist Camp Grands at Starling Junction there are 4 cost and 1 summer heariling-house, from which the sewage was condulty a covered drain into a desepted about 400 feet from the schore of Middle Waushaeum Pond. As the drain also received face water the desepted iverflowed after heavy rains, and its cont discharged into the running water, which eventually found its into the pend. To eliminate this nuisance four small filter-heach having an area of 300 square feet, were built near the sit the old desepted. The material at the site was not suitable for ill tion, and it was necessary to excavate the entire filtering prismeach bed and refill it to a depth of 5 feet with selected filtering terial. All soil and material excavated from the beds were used making the embankments.

An S-inch vitrified pipe drain S7 feet long connects the old di with a concrete regularing chamber which is provided with s planks, arranged in such a manner that water can be turned or any one of the four bods or any combination of them, and, when beds become filled, the water cannot rise higher than within a distance of the top of the embankments, as it will then overflow i an S-inch vitrified pipe drain which discharges into an open di below the beds. It was not deemed necessary to provide for filter all the water during heavy rainfalls, and this overflow will take c of all water exceeding the capacity of the beds, which is ample dur average conditions. It will not be necessary to operate the beds d ing the winter as the houses are not then occupied. centre and 3 feet below the surface of each bed a 4-inch vitrified pi underdrain is laid, parallel with the main feeder. These underdrain ompty into the open ditch at the same point as the 8-inch overflu drain. The above work was done by day-labor forces.

This plant was first put into operation on September 16, and I been in continual use ever since.

The work was begun on August 26 and finished on September? at a total cost of \$341.13.

FILTER BEDS IN STERLING ON WACHUSETT WATERSHED.



A small wooden building 8 feet by 12 feet has been built for the storage of tools and convenience of the keeper.

The water flowing in the brook was turned on to the beds on May 23, and the entire flow of the brook has been filtered since that date.

# Sterling Junction Filter-beds.

Immediately north of the main highway leading through the Methodist Camp Grounds at Sterling Junction there are 4 cottages and 1 summer boarding-house, from which the sewage was conducted by a covered drain into a cesspool about 400 feet from the south shore of Middle Waushacum Pond. As the drain also received surface water the cesspool overflowed after heavy rains, and its contents discharged into the running water, which eventually found its way into the pond. To eliminate this nuisance four small filter-beds, each having an area of 300 square feet, were built near the site of the old cesspool. The material at the site was not suitable for filtration, and it was necessary to excavate the entire filtering prism of each bed and refill it to a depth of 5 feet with selected filtering material. All soil and material excavated from the beds were used in making the embankments.

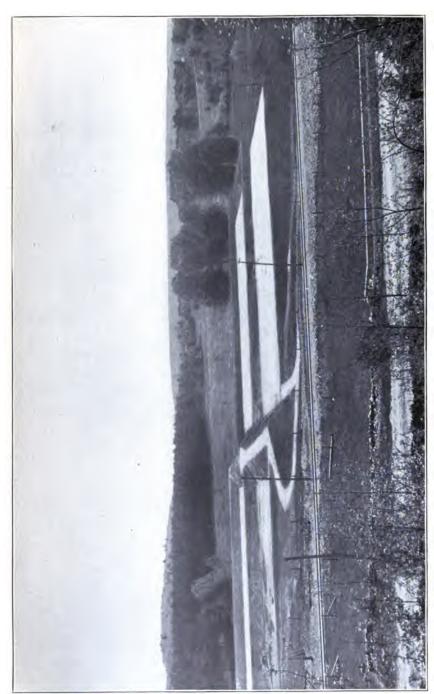
An 8-inch vitrified pipe drain 87 feet long connects the old drain with a concrete regulating chamber which is provided with stopplanks, arranged in such a manner that water can be turned on to any one of the four beds or any combination of them, and, when the beds become filled, the water cannot rise higher than within a safe distance of the top of the embankments, as it will then overflow into an 8-inch vitrified pipe drain which discharges into an open ditch below the beds. It was not deemed necessary to provide for filtering all the water during heavy rainfalls, and this overflow will take care of all water exceeding the capacity of the beds, which is ample during average conditions. It will not be necessary to operate the beds during the winter as the houses are not then occupied. Through the centre and 5 feet below the surface of each bed a 4-inch vitrified pipe underdrain is laid, parallel with the main feeder. These underdrains empty into the open ditch at the same point as the 8-inch overflow drain. The above work was done by day-labor forces.

This plant was first put into operation on September 16, and has been in continual use ever since.

The work was begun on August 26 and finished on September 21, at a total cost of \$541.13.

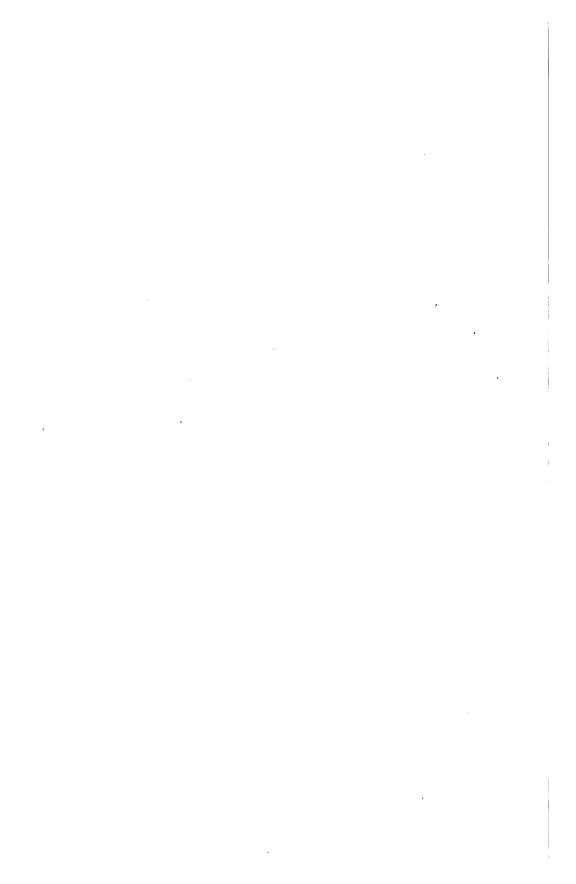
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FILTER BEDS IN STERLING ON WACHUSETT WATERSHED.





## Miscellaneous Work.

For the purpose of preventing objectionable drainage from entering the brooks running into the Wachusett Reservoir, 3 cesspools and 1 cemented vault have been constructed to take care of barn, sink and privy drainage in the town of Sterling.

On the Quinepoxet River, immediately above the circular dam at the head waters of the Wachusett Reservoir, the intervale land, which is very low, and is covered with a stand of heavy timber, is flooded in times of heavy flows. All the dead wood, brush, undesirable trees, etc., were cut and burned over an area of 14 acres extending upstream about 4,000 feet, to prevent the same from being washed into the reservoir.

At Dorr's Mill, on the Quinepoxet River, about 1½ miles above Oakdale, the stone walls of the mill have been razed, the cellar holes of the mill and tenement houses given a general cleaning up, and the head of the canal has been permanently closed by rock and gravel filling.

At Warfield's Mill all the apple trees have been cut into logs and cord wood and the cellar holes have been cleaned up.

At the Gates farm, on the south shore of Middle Waushacum Pond in Sterling, the old farmhouse and barns and five summer cottages have been destroyed, and wire guard fences have been built to keep within reasonable limits patrons of the steamer on the lake. On the boundary line adjoining property of the heirs of Andrew L. Fitch, 1,230 feet of wire fencing has been built along the top of an old stone wall, to keep cattle from trespassing. This was about one-half the total length of the line, repairs on the other half being made by the occupants of the Fitch farm.

#### ARLINGTON PUMPING STATION.

During the past year the pumping station building, which was partially constructed in 1906, has been completed, an engine and boilers have been installed, and a second engine is now being erected.

C. A. Dodge & Co., the contractor for the building, chimney and engine foundations, had at the beginning of the year completed about half of the work to be done under the contract. Masonry work was continued during the winter, whenever the weather was favorable, the roof trusses were erected early in March, and the contract was finished on July 19.

The Allis-Chalmers Company delivered the parts of the engine at the station during the latter part of July, and the engine was placed in regular service on December 4.

A contract for two boilers and a smoke flue for this station was made on January 30 with the Hodge Boiler Works of East Boston. The boilers and flue were delivered during September. The boilers have been set, the suction and delivery piping connected with the engine, the feed piping for the boilers and the heating and other miscellaneous small piping connected with the plant have been erected, and the grounds about the building graded by the maintenance force. A side track for the delivery of coal, built by the Boston & Maine Railroad, was completed and put in service on May 10.

On April 3 a contract was made with the Blake & Knowles Steam Pump Works for the delivery and erection of a compound, duplex, direct-acting pumping engine, having a capacity of 1,500,000 gallons per day. This engine was tested at the shop of the builder on December 23, and will be placed in position at the station in readiness for use early in the coming year.

The following is a description of the building and machinery. The main building is 90 feet by 46 feet on the outside, and it is about 26 feet from the ground to the cornice. The foundation walls are of Portland cement concrete, faced, where exposed on the outside below the water-table course, with seam-faced granite. terior walls are of dark-red faced brick, with Long Meadow brownstone trimmings, and are surmounted by a hip roof supported by steel trusses and covered with slate. The steps at the main entrance, the water-table course and the trimmings below the water-table are of pink Milford granite. The building is subdivided by a division wall forming an engine room 48 feet long by 40 feet wide and 24 feet high, and a boiler room 40 feet long by 35 feet wide and 33 feet high. the rear of the boiler room there is an underground coal pocket 33 feet long by 27 feet wide by 10 feet high, covered by a reinforced concrete roof over which the side track is carried. In this roof there are 16 openings through which coal may be unloaded from the cars. The brick chimney is in the rear of the building. It is 70 feet high and 8 feet in diameter at the base, diminishing to 5 feet in diameter at a point 6 feet below the top. The flue is 2 feet 6 inches in diam-The main entrance is on the front of the building.

vestibule is 7 feet by 9 feet, and on either side of it are the office and toilet room, both 8 feet by 9 feet, the three forming a projection from the main building 10 feet by 29 feet.

The interior facing of the engine and boiler room walls is of red brick. The engine room floor is of red quarry tile. The floors in the basement of the engine room and in the boiler and coal houses are granolithic.

The engine furnished by the Allis-Chalmers Company is a horizontal, cross-compound, fly-wheel engine fitted with Corliss valve gear, and operating two horizontal, outside packed, plunger pumps. The high and low pressure steam pistons are 14 inches and 28 inches in diameter, respectively, and the pump plungers  $8\frac{1}{2}$  inches in diameter, all having a stroke of 18 inches. The capacity of the engine at 65 revolutions per minute is 1,500,000 gallons in twenty-four hours.

The engine which is being erected by the Blake & Knowles Steam Pump Works is of the horizontal, cross-compound, direct-acting type, operating two outside packed, plunger pumps. The steam cylinders are 11 inches and 22 inches in diameter, the pump plungers 12 inches in diameter, and both pistons and plungers have a stroke of 18 inches. When operated at the rate of 31 revolutions per minute the capacity is 1,500,000 gallons per day.

There are two boilers of the horizontal, under-fired type, each 54 inches in diameter, containing 60 3-inch tubes 17 feet long. The furnaces are fitted with the Foster shaking grates, 4 feet wide by  $5\frac{1}{2}$  feet long.

The principal items of cost of this station to December 31, exclusive of engineering, are as follows:—

Building, including chimney and engine and boiler foundations,		<b>\$</b> 31,655 <b>62</b>
Allis-Chalmers Company engine (unfinished),		4,753 24
Boilers and setting,		5,983 03
Piping for engines, boilers, heating, etc.,		2,198 09
Side track,		721 23
Miscellaneous, including laying of suction and delivery pipes, gra	d-	
ing grounds, fencing and other work,	•	3,017 31

**\$48,328 52** 

# Additional Boiler at the Chestnut Hill High-service Station.

A contract for making and delivering at this station a 54-inch horizontal, tubular boiler, containing 102 3-inch tubes 18 feet long, was made with the Hodge Boiler Works of East Boston on January 30, in connection with a contract for the boilers at the Arlington station. This boiler was delivered on August 28, and has been set and connected by the maintenance force in readiness for use. It is of the same size and design as two boilers erected at the station in 1901, and has been set between these boilers, so that the three form a battery which will supply steam for the largest engine in the station without the use of other boilers. The cost of the boiler, with cast-iron front and smoke flue, delivered at the station, was \$2,976.

#### Engineering.

The engineering work, aside from that connected with the supervision of the contract and day-labor work in progress, has consisted principally of the following. The survey of the marginal line of the Wachusett watershed has been completed and the area of the watershed computed. The total length of the watershed line has been determined to be 78.93 miles, and the area of the watershed above the dam 118.19 square miles. Contour lines have been drawn on the final record sheets of the elevation of the bottom of the Wachusett Reservoir, covering an area of 323 acres, making a total of 4,123 acres covered by final record sheets on which the contour lines have been drawn, which completes this work except where the bottom of the reservoir has been changed because of the slide and repairs at the North Dike, and the caving of the shores at several points. The computing of the final capacity of the Wachusett Reservoir has been completed and tabulated, subject to slight revision when the caving of the steep slopes ceases. Record plans showing the contours of the bottom of the reservoir, the marginal lands, with highways, brooks, buildings, etc., have been largely completed. A general location and record plan of the Wachusett Reservoir has been made, showing property owned by the Board. Considerable progress has been made in making record plans of the Wachusett Aqueduct right of way.

A considerable portion of the time of the drafting force has been devoted to the completion of record plans of the Wachusett Dam,

Weston Reservoir and the Clinton Sewerage Works. Other work done by this force has been the preparation of plans for boilers and setting at the Arlington and Chestnut Hill stations, for floor plates and piping at the Arlington station, and studies for design for floor of the lower gate-chamber at the Wachusett Dam.

## MAINTENANCE.

## RAINFALL AND YIELD.

The total rainfall for the year on the Sudbury watershed has been 44.38 inches, or 1.61 inches below the average for thirty-three years. On the Wachusett watershed the total rainfall has been 45.74 inches, or 3.25 inches below the average for the past eleven years, during which the records have been kept. On both of these watersheds the yield during the first six months of the year was much below the average, that of the Wachusett watershed for the period being 1,170,000 gallons per square mile per day, which is 30 per cent. below the average for the past eleven years, and less than any previous record for this watershed. During the last four months of the year, however, the rainfall and yield were larger than usual, and for the whole year the yield of both the Sudbury and Wachusett watersheds is but little below the average.

Statistics relating to rainfall and yield of watersheds may be found in Appendix No. 3, tables Nos. 1 to 11.

## STORAGE RESERVOIRS.

The quantity of water stored in all of the storage reservoirs on January 1, 1907, was 44,153,200,000 gallons. During the month of January there was an increase of a little less than 2,600,000,000 gallons in the quantity stored, but during February, and until March 14, there was a loss in storage amounting to 2,000,000,000 gallons. There was a gain of 4,800,000,000 gallons during the latter half of March, 3,000,000,000 gallons in April, 900,000,000 gallons in May, and on June 11 the total was 54,369,400,000 gallons. From this date until September 23 there was an almost continual reduction in the quantity of water stored, the total loss being 8,840,000,000 gallons. As a result of rainfalls amounting to about 25 inches during the last four months of the year, the gain in storage from September 23 to January 1, 1908, was approximately 20,000,000,000,000 gallons,

and the maximum of storage for the year was reached on December 31.

The following table gives the quantity of water stored in the storage reservoirs at the beginning of each month:—

Quantity of Water stored in Wachusett Reservoir, and in Reservoirs on Sudbury and Cochituate Watersheds, at the Beginning of Each Month.

DATE.					In Wachusett Reservoir (Gallons).	In Sudbury Reservoir and Framingham Reservoir No. 3 (Gallons).	In All Other Storage Reservoirs (Gallons).	Total (Gallons).	
	19	07.							
January 1,		•			•	31,752,900,000	6,748,900,000	5,651,400,000	44,153,200,000
February 1,		•		•	•	34,071,500,000	6,536,600,000	6,143,800,000	46,751,900,000
March 1,	•	•	•		•	33,416,800,000	6,177,900,000	5,705,000,000	45,299,700,000
April 1, .		•			•	36,703,600,000	6,336,000,000	6,462,400,000	49,502,000,000
May 1, .		•	•		•	38,580,300,000	7,032,600,000	6,967,000,000	52,579,900,000
June 1,	•	•	•		•	38,300,700,000	7,878,300,000	7,292,700,000	53,471,700,000
July 1,	•	•	•		•	38,664,500,000	7,841,500,000	7,122,300,000	53,628,300,000
August 1,	•	•	•		•	36,875,400,000	7,856,500,000	6,212,500,000	50,944,400,000
September 1,		•	•		•	34,741,600,000	7,968,200,000	4,358,700,000	47,068,500,000
October 1,	•	•			•	35,480,400,000	8,037,000,000	3,489,400,000	47,006,800,000
November 1,					•	38,772,600,000	7,437,600,000	3,854,300,000	50,064,500,000
December 1,	•	•	•	•	•	46,110,300,000	7,937,100,000	5,216,200,000	59,263,600,000
	19	08.							
January 1,						51,267,000,000	7,947,300,000	6,645,200,000	65,859,500,000

Wachusett Reservoir. — At the beginning of the year the water in this reservoir was at elevation 364.57, and the reservoir contained 31,752,900,000 gallons. On account of the small yield of the watershed during the first half of the year, and on account of the draft for the supply of the Metropolitan District, the rise of the reservoir was small, and from January 1 to the middle of June the surface rose but 8.40 feet, to elevation 372.97. From June 19 to September 23 the reservoir surface fell 5.59 feet, and after the latter date until the end of the year there was an almost continuous and at times rapid rise, amounting to 16.93 feet, making the net rise for the year 19.74 feet, equivalent to a gain in storage of 19,514,100,000 gallons. The only water discharged from the reservoir into the river below the dam was that required for the use of the Lancaster Mills. surface of the Lancaster Mills Pond was kept up to the crest of its dam until the middle of August, after which the water level was lowered about 1 foot, in order to prevent the water from splashing over the crest of the dam. The average quantity as measured at the Clinton gaging station below the Lancaster Mills was 3,884,000 gallons per day.

The 50-foot marginal strip along the full reservoir flow-line has

been kept mowed, and miscellaneous rubbish has been collected from time to time along the shore line of the reservoir and burned.

At nineteen points around the reservoir, where main highways and driveways were discontinued, barways or gates have been built for the protection of the public.

The heavy rains during the late summer washed out large gulleys in the banks of the reservoir at the Sawyer's Mills shallow-flowage fill on the north shore, near the entrance of Gates Brook on the south shore, and on the Stillwater River branch in Oakdale. To prevent this in the future paved gutters have been built, having an aggregate length of 220 feet.

The grass from 306 acres of land on the North and South dikes, and marginal lands in Sterling, Clinton, Boylston and West Boylston has been sold at auction for \$1,999.50, and from 93 acres on the outlying lands for \$273.00.

At the Wachusett Dam the maintenance work, consisting of the operation of the valves controlling the flow of water, the cleaning of screens, taking care of the gate-chambers and of the grounds above and below the dam has been done by three gate-keepers, assisted by from two to four laborers whenever necessary.

Since the works were completed the discharge of water from the reservoir into the lower gate-chamber was until October controlled by the use of 24-inch valves in the lower gate-chamber, which were operated under a pressure of about 35 pounds. This method of operation caused a vibration of the pipes, which not only made a continual objectionable noise, but also caused the pipes to work loose in their beds, the leaded joints to leak, and the 1½-inch diameter bolts, with which the flanges of the pipes are bolted together, to work loose, and in some cases to break off. It was found by experiment that by opening the sluice gates in the upper gate-chamber so as to discharge the exact quantity desired, and regulating the 24-inch valves in the lower gate-chamber so that they operated under a pressure of 13 pounds per square inch, the noise and vibration could be almost entirely eliminated. This method of operation has been used since October 15, with apparently entirely satisfactory results.

Both the exterior and interior woodwork of the upper and lower gate-chambers and of the chamber in the bastion were painted, also iron fences and other ironwork about the dam.

Sudbury Reservoir. - At the beginning of the year the water in

this reservoir stood at elevation 256.45, or 2.55 feet below the stone crest of the overflow. Until April 20 the water was kept from 3 to 4 feet below the stone crest, in order to provide storage in case of large yields from the watershed. From May 14 until October 11, and from November 7 to the end of the year, all water flowing from this reservoir into Framingham Reservoir No. 3 flowed over the crest of the Sudbury Dam. A longitudinal joint on the up-stream face of the dam, between 2 and 3 feet below the crest, also some vertical joints extending upwards toward the crest, were cut out and repointed. A blind drain was built around the foot of the southerly wingwall of the dam, where the ground had always been wet. A 4-strand twisted wire fence, 375 feet long, was built between land of the Commonwealth and Alonzo Newton.

New stairways have been built on the slopes of the embankment on either side of the overflow, constructed with hard-pine treads and cypress stringers supported by chestnut posts.

The interior iron and wood work in the gate-house and the roof of the house occupied by the foreman have been painted.

Work has been continued as opportunity offered on a service road around the northerly side of the reservoir.

The 14 acres of filter-beds, which are used in filtering the water of Marlborough Brook, were cleaned in June, and the beds were weeded in September and October. There was no overflow from the beds into the reservoir during the year.

There was but little flow of sewage into the small basin and filter-bed near Farm Road, which receives the overflow from the Marlborough main sewer during freshets, but there was a flow of ground water into the basin during the spring and fall. The filter-bed was cleaned.

Framingham Reservoir No. 3.— The elevation of the water in this reservoir is controlled by drafts from the Sudbury Reservoir, and during the greater portion of the year its surface was from 1½ to 3 feet below the stone crest of the overflow. After October 10 the reservoir was kept about 3 feet below the crest of the dam, in order to facilitate the work of widening and relocating Worcester Street. In order to enable the Boston & Worcester Street Railway Company to lay a double track, and at the same time to improve the grades and do away with numerous sharp curves, the width of Worcester Street between Framingham Centre and Southborough has been increased to 75 feet, and its location radically changed at

several points. The new location encroaches upon both Framingham reservoirs Nos. 1 and 3, and the necessary filling reduces the capacity of Reservoir No. 1 by 1,200,000 gallons, and of No. 3 by about 3,500,000 gallons. Where the street crosses Framingham Reservoir No. 1 the widening will necessitate the lengthening of the abutments and the rebuilding of the bridge over the reservoir. portion of the work has not yet been commenced, but the filling into Reservoir No. 3 and the repaying of the slopes have been completed. All of the work is being done by and at the expense of the Boston & Worcester Street Railway Company, and the interest of the Metropolitan Water and Sewerage Board has been to see that the work was carried on in such a manner as not to injure the property of the Commonwealth. With this object in view a movable boom, from which was suspended a weighted canvas reaching to the bottom of the reservoir, was placed in front of the place where filling was being dumped into the reservoir, so as to prevent the roily water from being spread through the reservoir and carried into the aqueduct. A large portion of the material used for filling was a clayey hardpan, but where exposed to the water this was faced with 2 feet of clean gravel, on which was placed paving 12 inches to 18 inches in thickness, above the water level, for a vertical height of 6½ feet, and riprap of about the same thickness below the water to the foot of the slopes. length of the slopes repayed on both sides of the roadway in Reservoir No. 3 was about 2,000 feet.

Framingham Reservoir No. 2.— This reservoir was full during the greater portion of the year. Water for the supply of the Metropolitan District was drawn from the reservoir from May 14 to October 12, and on a few days in October and November water was drawn from the reservoir to replenish Lake Cochituate. The woodwork of the floor of the Fountain Street bridge crossing this reservoir has been entirely renewed. The floor stringers were made of 4-inch by 14-inch hard pine, the bottom floor of 3-inch hard-pine plank and the top floor of 2-inch chestnut. All of the hard-pine stringers were treated with Conservo, for preservation. The stringers of this bridge had not been renewed since the bridge was built in 1879. A wire fence 625 feet long was built on the line of Fountain Street, near the head of the reservoir.

Framingham Reservoir No. 1. — This reservoir was substantially full throughout the year, except for short periods in October and November, when water was drawn from it to replenish Lake Cochit-

uate. In addition to the 1,500,000 gallons required to flow past the dam daily, water was wasted in every month of the year except during July, August and September. The barn at the Bullard place, used by the foreman in charge of the Framingham, Ashland and Hopkinton reservoirs, has been shingled and painted.

Ashland Reservoir. — This reservoir was full at the beginning of the year and water was wasted at the overflow for the greater portion of the time until July 23, when the reservoir was drawn upon for the supply of the Metropolitan District. During the following two months the reservoir fell rapidly, and on September 29, when the outlet gates were closed, the reservoir surface was 25.75 feet below high water. During October, November and December the reservoir was constantly rising, and on January 1, 1908, was 4.73 feet below high water.

Hopkinton Reservoir. — At the beginning of the year the water in this reservoir was at elevation 303, or 2 feet below high water, but on January 2 water was wasting over the waste-weir, and continued to waste until the early part of February, when the reservoir was lowered about 1½ feet. In April it was allowed to rise and flow over the waste-weir, and in May over the flash-boards. A draft for the supply of the Metropolitan District was started on July 11, and the water fell rapidly until September 29, when the outlet gate was closed, the reservoir surface being then 24.95 feet below high water. On January 1, 1908, the reservoir had refilled to elevation 300.66, or 4.34 feet below high-water mark. The barn used by the attendant was shingled, and the filter-beds below the dam were twice cleaned during the year.

Whitehall Reservoir. — This reservoir was kept near high-water mark except during the early spring. No water was drawn from the reservoir for the supply of the Metropolitan District. More attention than heretofore has been given to the regulation of boating and to the enforcement of sanitary regulations, resulting in improved conditions. There are now 27 cottages around the reservoir occupied by summer residents, and about 77 boats of different kinds upon the reservoir.

Farm Pond. — As the town of Framingham has drawn a portion of its supply directly from the Sudbury Aqueduct instead of from the filter gallery alongside the pond it has not been found necessary to replenish the pond during the year from the Framingham reservoirs, as has been customary in the past. The elevation of the

pond has ranged between high-water mark and 1½ feet below that point.

Lake Cochituate. — The water in the lake at the beginning of the year was 5.8 feet below high water. Although the rise of the lake was retarded by a flow into the Cochituate Aqueduct from February 12 to April 9, it reached high water on April 16, when water was permitted to waste at the outlet dam. The waste was continued until June 12, when a flow in the Cochituate Aqueduct from that date to the 24th prevented the necessity of further waste. The flow in the Cochituate Aqueduct was again started on July 12, and the water in the lake fell to 7.2 feet below high water on September 28, after which date, aided by heavy rains and a supply of water from Framingham reservoirs Nos. 1 and 2, the lake rose to within 0.09 of a foot of high water at the end of the year. The flow started in the Cochituate Aqueduct on July 12 was maintained without interruption to December 6.

During the year considerable repair work was done at the house occupied by the foreman and the barn was shingled. The hard-pine floor of the walk crossing the overflow at the outlet dam was renewed, and the bridge crossing the stream below the dam was rebuilt with the best of the timber taken from the Fountain Street bridge at Ash-Both the exterior and interior wood and iron work of the effluent gate-house were painted, also the ironwork at the outlet dam. Two hundred and fifty stone bounds, 4 feet 6 inches long, were cut, by contract, from stones removed from the old outlet dam. stone property bounds which were originally set around the lake were small, and only about 18 inches in length, of which 5 or 6 inches was set above the level of the ground. As a result many of the bounds have been thrown out of position by the frost, or pulled up and lost, so that it is often difficult to determine the exact location of the property lines. During the past year 13 bounds, 4 feet 6 inches long, were set at points where there were no bounds, and there are now 75 points where no bounds are set and about 300 points where the short bounds should be replaced by longer bounds of our present standard. This work it is proposed to do during the coming year. During the fall and early winter, while the water was low in the lake, all rubbish on the shores and a large quantity of leaves which had collected in the coves were removed. The widening of the road-bed of the Boston & Albany Railroad, so as to accommodate four tracks, necessitated the lengthening of the stone arch

culvert over the Beaver Dam Brook arm of the lake, also some filling into the lake at other points. Care was taken to see that suitable materials were used for this purpose, and a careful sanitary inspection was maintained, not only at the crossing of the lake but also wherever there was possibility of pollution of the tributaries of the lake.

The registration of boats used on the lake, which was inaugurated in 1906, was continued with satisfactory results. One hundred and seventy-six applications for registration were received and 142 were granted. The season was extended from September 20 to October 15, but only a few of the cottagers remained to the end of the season. Four new cottages were built and 1 burned, making the number at the end of the year 59.

No water has been turned from Dudley Pond into Lake Cochituate, and the elevation of the pond has ranged between 3.81 and 2.56 feet below high water during the year. There are 18 summer cottages on the shore of the pond.

The surface of Dug Pond has varied between 0.48 of a foot above and 2.27 feet below the invert of the 18-inch overflow pipe.

Water was pumped on to the Pegan Brook filter-beds on 228 days during the year. The total quantity pumped was 305,859,000 gallons, of which 266,000,000 gallons were from Pegan Brook and 98,859,000 gallons from the intercepting ditch which collects water from the brooks formerly draining into Pegan Brook Meadow. The total quantity of coal consumed was 196,705 pounds, so that 1,555 gallons of water were pumped per pound of coal. The cost of operating the pumping station, cleaning the filter-beds and caring for the grounds was \$2,841.14, making the cost per million gallons \$9.29. The filter-beds have been cleaned and the ditches in the upper part of the receiving reservoir were cleaned twice during the year. The intercepting ditch on the east side of Pegan Meadow was cleaned in the fall. The widening of the road-bed of the Boston & Albany Railroad, to accommodate two additional tracks, has decreased somewhat the storage capacity of filter-bed No. 6.

Sources from which Water has been taken.

An average of 82,589,000 gallons of water per day was drawn from the Wachusett Reservoir through the Wachusett Aqueduct into the Sudbury Reservoir. An average of 30,350,000 gallons per day was drawn from the Sudbury Reservoir through the Weston Aque-

duct into the distribution system of the Metropolitan Water District. From Framingham Reservoir No. 3 an average of 72,929,000 gallons per day and from Framingham Reservoir No. 2 an average of 11,726,000 gallons per day was drawn through the Sudbury Aqueduct to Chestnut Hill Reservoir. An average of 11,398,000 gallons per day was drawn from Lake Cochituate through the Cochituate Aqueduct to Chestnut Hill Reservoir. The Spot Pond drainage area furnished 418,000 gallons per day.

# AQUEDUCTS.

The Wachusett Aqueduct has been in use on the whole or a portion of 333 days during the year. The usual annual cleaning of the aqueduct has been deferred until some convenient time in the early part of next year. During the early summer 2,751 feet of galvanized ribbon wire fencing was built along the westerly side of the aqueduct land in the town of Northborough, between Pierce's bridge and the crossing of the New York, New Haven & Hartford Railroad, to prevent cattle pastured on adjacent land from trespassing on the embankment.

A new flight of chestnut steps, 53 feet long, has been placed on the slope of the aqueduct embankment at the westerly end of the Assabet Bridge in Northborough.

The usual work of cutting brush and weeds, cleaning out culverts and berm ditches, and general repairs along the aqueduct and open channel has been done. All fruit trees on the aqueduct land have been cut and worked up into cordwood. The fences and other ironwork at the terminus of the aqueduct in Southborough have been painted.

The Sudbury Aqueduct was in use on 357 days of the year for conveying water from reservoirs Nos. 2 and 3 to Chestnut Hill Reservoir, and on 7 days for conveying water from reservoirs Nos. 1 and 2 to Lake Cochituate. The flow was interrupted for a few hours on each of 2 days for the purpose of examining a sluice gate at Framingham Dam No. 1, and for the purpose of repairing the screen grooves at the Farm Pond gate-house, and also on 4 other days when changing the direction of the flow from into Chestnut Hill Reservoir to Lake Cochituate, or the reverse.

The joints in the masonry of culvert No. 6, at station 83+75, in Sherborn, were cut out and repointed. The central joint in the granolithic covering of Echo Bridge was pointed with elastic cement.

The paved slopes of the aqueduct embankment in Farm Pond have been repaired. The iron floor beams and gratings in the east siphon chamber and in the Course Brook, Bacon's and Fuller's waste-weirs, the stop-planks at the waste-weirs and the stairway railings at Echo Bridge, and iron doors and manhole covers at both the Echo and Waban bridges, have been painted.

The city of Newton has laid a surface water drain in Walnut Street, which is connected with manholes built on either side of a stone culvert 40 feet long, which was constructed under the aqueduct when it was built. The culvert was constructed 3 feet square, but a sewer and subdrain, embedded in concrete, have been laid through the lower portion, and the surface water is to be carried in the space 3 feet wide and 16 inches high remaining above the sewer.

The Cochituate Aqueduct was in use 216 days. It was cleaned from Lake Cochituate to the Chestnut Hill pumping station in April, with the exception of the siphon pipes at the crossing of the Charles River.

The work of setting property bounds along the aqueduct line, which has been in progress for several years, was completed in January, and in December 264 short property bounds were replaced by standard bounds 4 feet 6 inches long.

On December 9 the city of Newton began the work of laying a 15-inch Akron pipe sewer and a 12-inch Akron pipe underdrain under the aqueduct, at station 169, which is just west of the Waban Station on the Boston & Albany Railroad. The invert of the 12-inch underdrain at the point of crossing is 28 feet and 6 inches below the top of the aqueduct embankment. The material through which the sewer is laid is a very fine sand, holding sufficient water to give it a tendency to run into any excavation. Carefully sheeted trenches were excavated on either side of the aqueduct, and an attempt was made to force steel cylinders 6 feet long and from 4 feet to 4 feet 10 inches in diameter through the intervening distance of about 25 feet under the aqueduct. Three cylinders were forced in a total distance of 16 feet, and for the remaining distance cast-iron pipes to be used for the sewer and subdrain, were forced through the sand with-The Akron pipes were then laid out the use of the steel cylinders. through the cylinders and the cylinders filled with concrete. flow through the aqueduct was stopped while the work was in progress, and the earth above the aqueduct was removed to relieve the pressure on the masonry. An inspection of the interior of the aqueduct for 50 feet on either side of the crossing, made after the work was finished, revealed no indication of any settlement of the aqueduct or of the earth under it.

The Weston Aqueduct was in use 359 days. The portion of the aqueduct between siphon chamber No. 4 and the entrance to tunnel No. 4, a distance of 16,500 feet, was cleaned during the week ending April 13.

The building of a barn at the White place, for the use of the foreman, was completed during the winter, and late in the year a supply of water was brought into the barn by laying 210 feet of 1-inch pipe, connecting with a pipe leading from a small reservoir on the hill in the rear of the barn. Both the new and old barns have been painted, also all the ironwork in the head-house near the Sudbury Dam, the woodwork in the interior of the 4 siphon and 2 gaging chambers, and the manhole covers and iron ladders in the manholes between the head-house and siphon chamber No. 4.

#### PUMPING STATIONS.

Seventy-five per cent. of all the water supplied to the Metropolitan District has been pumped at the two stations at Chestnut Hill Reservoir; the remainder was delivered by gravity. The total quantity pumped at all the stations during the year was 38,213,520,000 gallons, which was 8.6 per cent. more than during the preceding year. The cost of operating the stations was \$112,248.67, equivalent to \$2.937 per million gallons pumped, or \$0.027 more than the corresponding cost during the year 1906. There was an increase in the cost of labor for operating the stations, amounting to \$5,604.81. This increase was due to two causes; first, to the decrease in the hours of labor of the pumping station employés from fifty-six to forty-eight hours per week, which went into effect on November 1, 1906, and necessitated an increase in the number of men employed, and second, to an increase of 10.6 per cent. in wages, which went into effect on April 1, 1907.

The cost per gross ton of fuel used at the Chestnut Hill high-service station was \$0.26 less and at the Chestnut Hill low-service station \$0.07 less, while at the Spot Pond station it was \$0.05 greater than during the preceding year. The increased cost of labor has been offset to some degree by a reduction in the price of fuel, which, in connection with the increase in the quantity pumped, has

resulted in making the average cost at all the stations of raising one million gallons one foot high exactly the same as during the year 1906, or \$0.0329.

All bituminous coal purchased for use at the several pumping stations has been tested to determine the number of British thermal units and the percentage of volatile matter and ash which it contained, and the cylinder and engine oils have been tested to determine their viscosity, specific gravity and burning point. Seventy-three samples of coal and 22 samples of oil were tested.

Coal for use at the several stations has been purchased as follows:—

	-					
	Chestnut Hill High- service Station.	Chestnut Hill Low- service Station.	Spot Pond Station.	West Roxbury Station.	Arling- ton Station.	Price per Gross Ton, in Bins.
Wm. A. Jepson, bituminous,	1,688.14	-	-	-	_	\$4 14
E. B. Townsend, bituminous,	1,586.62	-	-	-	-	4 09
E. B. Townsend, bituminous,	-	896.61	-	-	·-	4 00
Wm. A. Jepson, bituminous,	-	1,444.28	-	_	-	3 99
C. W. Claffin & Co., buckwheat an-	2,291.38	_	-	-	-	2 97
thracite. C. W. Claffin & Co., buckwheat an-	-	1,635.15		-	-	2 87
thracite. Locke Coal Company, bituminous,	-	_	543.77	_	-	5 00
Locke Coal Company, bituminous, .	_	_	411.01	_	-	4 35
Locke Coal Company, screenings, .	_	-	424.51		-	2 24
D. J. Cutter & Co., anthracite,	-	_	-	350.53	_	7 28
Peirce & Winn Co., bituminous,	_ 1	-	-	_	5.89	6 05
Locke Coal Company, bituminous, .	_	_	-	_	100.79	5 25
Wm. A. Jepson, bituminous,	_	_	_	_	23.39	5 07
Locke Coal Company, bituminous,	_	_	_	_	199.94	5 00
Wm. A. Jepson, bituminous	_	_	-	_	184.73	4 59
Locke Coal Company, bituminous,	-	_	_	_	115.00	4 48
C. W. Claffin & Co., buckwheat an-	_	_	_	_	35.05	3 01
thracite, Peirce & Winn Co., screenings,	_	_	_	_	190.08	2 24
Total gross tons, bituminous,	3.274.76	2.340-89	954.78	_	629.74	ļ <del></del>
Total gross tons, anthracite,	2,291.38	1,635.15	-	350.58	35.05	_
Total gross tons, anthracite screen-	_	_	424.51	_	190.08	_
ings. Average price per gross ton, bituminous,	\$4 12	<b>\$3</b> 99	\$4 72	-	\$4 84	· -
Average price per gross ton, anthracite,		2 871	_	\$7 28	3 011	_
Average price per gross ton, anthracite screenings.	-	-	2 24	-	2 24	-

<sup>1</sup> Buckwheat.

## Chestnut Hill High-service Station.

At this station water is pumped for use in the high-service district of Boston, the city of Quincy and the towns of Watertown, Belmont and Milton.

The following are the statistics relating to operations at this station:—

		Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	Totals for Station.
Total quantity pumped (million gallons),	•	2,235.69	209.93	10,852.97	13,298.59
Daily average quantity pumped (gallons),		6,125,000	575,000	29,734,000	36,434,000
Total coal used (pounds),		3,639,708	208,364	8,961,000	12,809,072
Gallons pumped per pound of coal, .		614.25	1,007.52	1,211.13	2,939.97
Average head pumped against (feet), .		121.65	129.16	131.79	130.04
Cost of pumping: —					
Labor,		\$5,785 17	<b>\$269 56</b>	<b>\$14,680 63</b>	\$20,735 36
Fuel,		6,125 41	326 15	14,998 32	21,449 88
Repairs,		1,463 32	1,274 23	1,911 35	4,648 90
Oil, waste and packing,		134 88	6 28	342 28	483 44
Small supplies,		193 30	9 01	490 54	692 85
Totals,		\$13,702 08	<b>\$1,885 23</b>	<b>\$32,423</b> 12	\$48,010 43
Cost per million gallons pumped,		\$6.129	<b>\$8.980</b>	\$2.987	\$3.610
Cost per million gallons raised 1 foot high,		0.050	0.070	0.023	0.028

The daily average quantity pumped was 1,557,000 gallons, or 4½ per cent. more than during the previous year.

Between January 19 and March 22 extensive repairs were made on the furnaces of the No. 4 90-inch Belpaire boiler. The side sheets of the two furnaces, which were bulged and cracked, were cut out and replaced with four new sheets each 9 feet long, 33 inches wide and %6 of an inch thick. The work was done with great care, all rivet holes were drilled with the sheets in place, and the shanks of all rivets were turned in a lathe so as to fit the holes when the rivets were hot. The new stay bolts used were 1½ inches in diameter, or % of an inch larger than the old ones. The work was difficult, owing to the construction of the boiler, but was successfully accomplished, and the boiler has been in use since May 11, with no

signs of leakage. The work on the boiler was done by the Hodge Boiler Works of East Boston, at a cost of \$1,791, and the work of removing the boiler covering, raising and lowering and reconnecting the boiler was done by the regular pumping station force, at a cost of about \$300. The exterior woodwork and ironwork of the pumping station was repainted in October and November, and considerable of the interior woodwork refinished. In connection with the installation of a new boiler, concrete foundations have been placed under boilers Nos. 1 and 2. These boilers were originally erected on a foundation of concrete 4 feet in thickness, which in turn rested on filling about 13 feet in depth, which contained large tree stumps and other organic matter. As a result of these conditions the boilers settled several inches, and to prevent further settlement four concrete piers 2½ feet by 6 feet were built under each boiler, extending down to hard material, which was, on the average, 171/2 feet below the engine room floor. A concrete arch 21 feet 9 inches long, having a span of 5 feet, a rise of 22 inches and a thickness of 8 inches at the crown, was built between the foundations of boilers Nos. 1 and 2 to form the foundation for the new boiler. The concrete used in constructing the piers and arch was made with Alpha Portland cement, sand and stone, mixed in the proportion of one part of cement, three of sand and six of stone. The cost of these foundations was approximately \$1,200.

On August 31 the high-pressure piston of the No. 2 Holly engine became detached from the piston rod, and as a result the rear cylinder head of the engine was blown out, rendering the engine useless. Arrangements were at once made with The Atlantic Works of East Boston to make a new cylinder and piston. The making of new patterns and castings, and of doing the necessary machine work, occupied about three months. The new cylinder was delivered at the station on December 13, and at the end of the year the engine was nearly ready to be placed in service.

# Chestnut Hill Low-service Pumping Station.

The quantity of water pumped at this station was 11.9 per cent. more than during the preceding year.

The following are the statistics relating to operations at this station:—

													Engines Nos. 5, 6 and 7.
Total quant	ity pu	mped	(m	illion	gallo	ns),						:	21,198.08
Daily avera	ge qu	antity	pui	nped	(gall	ons),							58,077,000
Total coal v	sed (	pound	ls),	•									9,057,261
Gallons pur	nped	per p	ound	of c	oal,	•							2,340.45
Average he		-				,					•		, 54.70
Cost of p	umpin	ıg : —											
Labor, .	•	•											<b>\$18,494</b> 76
Fuel, .													15,163 81
Repairs,													816 35
Oil, waste s	ind pa	cking	,						•				475 98
Small supp	-		•	•	•	•	•	•					428 07
Total fo	or stat	ion,			•								<b>‡</b> 35,378 97
Cost per mi	illion g	gallor	s pr	ımpe	d,		٠.						\$1.669
Cost per mi	illion į	gallor	ıs ra	ised	l foot	high	,			•	•		0.031

The cost per million gallons pumped was \$0.021 less than for the year 1906.

No repairs of any magnitude have been necessary on either the engine or boilers, and the machinery is now in good condition. The exterior woodwork of the station has been painted.

# Spot Pond Pumping Station.

At this station practically all of the water was pumped with the 20,000,000-gallon Holly engine, engine No. 8 having been in operation only ninety-five hours and thirty minutes during the year.

The following are the statistics relating to operations at this sta-

tion:—									То	tals for Station. Engines Nos. 8 and 9.
Total quantity p	umped	(millio	n gall	ons)	), .					3,267.82
Daily average q										8,953,000
Total coal used	(pound	3), .			•					2,816,358
Gallons pumped										2,106.28
Average head p										129.76
Cost of pump	ing:—									
Labor,	U								٠.	\$8,571 09
Fuel,										5,055 61
Repairs, .										141 65
Oil, waste and p										240 06
Small supplies,	٠.									<b>24</b> 0 <b>59</b>
Totals, .										<b>\$14,249</b> 00
Cost per million	gallon	s pump	ed,							<b>\$4.360</b>
Cost per million	U			t hig	gh,		•	•		0.034

The cost per million gallons pumped was \$0.334 more than for the previous year. There was an increase of \$0.39 per million gallons in the cost of labor and \$0.07 in the cost of fuel, these increases being offset by a decrease in the cost of repairs and small supplies.

The exhaust valve stem on the No. 8 engine was broken on August 13 while starting the engine after it had been out of service for several months, and on August 15 a dash pot and collar broke on engine No. 9. In both cases the repairs were made by the regular force, at small expense.

During October and November the exterior woodwork and ironwork of the station was given two coats of paint, and the interior wood finish was cleaned and varnished.

## Arlington Pumping Station.

At this station was pumped all the water supplied to the town of Lexington and to the high-service district of Arlington.

The following are the statistics relating to operations at this station: —

Pumps ope	erated 8	3,710	hou	rs 30	minu	tes;	avei	age,	24 h	ours	per d	ay.	
Daily aver	age qu	antit	y of	wate	r pun	ped	(gal	lons),					636,000
Daily aver	age qu	antit	y of	coal	consu	med	(por	ınds),					4,370
Gallons pu	imped	per p	oun	d of (	coal,								146
Average 1	ift in fe	et,	•	•			•	•		•	•	•	282
Cost of	pumpin	g:_											
Labor, .	•	٠.											<b>\$</b> 4,316 71
Fuel, .													3,552 96
Repairs ar									•		•		422 93
Total	for stat	ion,											\$8,292 60
Cost per n	aillion g	gallo	ns p	ump	ed,								<b>\$35.72</b> 9
Cost per n	aillion g	gallo	ns r	aised	1 foo	t hig	h,	•	•	•	•		0.127

On account of unexpected delays in the erection of the machinery in the new station, which has been under construction for two years, the old engines have been kept in service nearly the entire year. The Allis-Chalmers engine at the new station was operated for short periods on a few days during the latter part of November, and has been in regular service since December 6. As the reserve engine in the new station is not yet erected, fires are still maintained under the boilers at the old station, so that the plant is in readiness for immediate use. On account of the necessity of maintaining fires at both the old and new stations, and on account of the increased cost of labor, the cost of operation has been larger than during the preceding year.

## West Roxbury Pumping Station.

At this station water was pumped for supplying the higher portions of West Roxbury and Milton.

The following are the statistics relating to operations at this station:—

Pu	mps oper	ated 8	,335	hor	ırs 30	) minu	tes;	aver	age,	23 h	urs	per d	ay.	
Da	ily avera	ge qua	antit	y of	wate	er pun	aped	l (gal	lons)	١, .		•	٠.	594,000
Da	ily avera	ge qua	ntit	y of	coal	consu	med	l (pou	nds)	, .				2,127
Ga	llons pun	aped p	er p	our	ıd of	coal,		•	•					279
Av	erage lift	in fe	et,	•	•	•	•	•	•	•	•	•	•	139
(	Cost of pu	ımpin	g : —	-										
La	bor, .													\$3,471 11
Fu	el, .													2,552 13
Re	pairs and	smal	l sup	pli	98, .		•			•	•	•	•	294 43
	Total fo	or stat	ion,		•									<b>\$6,317</b> 67
Co	st per mi	llion g	gallo	ns j	oump	ed,								<b>\$</b> 29.124
Co	st per mi	llion g	gallo	ns i	aisec	l 1 foo	t hi	gh,			•			0.210

The quantity pumped was 52,000 gallons per day, or 8 per cent., less than during the previous year, due to the discovery and repair in the latter part of 1906 of a number of leaks in the piping system in West Roxbury.

No extensive repairs have been required on the machinery, but the pumps are old, and, as it is necessary at times to operate both of the pumps to their full capacity, it will be necessary within a very few years to enlarge the plant unless a considerable reduction in the consumption can be made by saving water now wasted.

#### CONSUMPTION OF WATER.

The daily average quantity of water consumed in the cities and towns supplied from the Metropolitan Water Works during the year 1907, as measured by the Venturi meters, was 124,135,100 gallons, equal to 133 gallons per inhabitant in the district supplied. In addition to the above, 50,000 gallons daily were supplied to the United

States Government reservation on Peddock's Island. The daily average quantity supplied to the Metropolitan Water District, as determined by pump measurement and by the flow in the Weston Aqueduct and the estimated yield of Spot Pond, was 125,071,000 gallons, equal to 133.8 gallons per inhabitant. The excess difference of 885,900 gallons per day between the quantity delivered by the aqueducts and that measured by meters to the several municipalities is due to differences in methods of measurement, to leakage from the Metropolitan Water Works reservoirs and pipes, and to the use of water at the Chestnut Hill and Spot Pond pumping stations.

The daily average consumption of water in each of the cities and towns supplied from the Metropolitan Works during the years 1906 and 1907, as measured by the Venturi meters, was as follows:—

			DAII	LY AVERAGE	Consumption		
	Estimated Population.	19	D <b>6.</b>	19	07.		
	1907.	Gallons.	Gallons per Capita.	Gallons.	Gallons per Capita.	Increase.	Decrease
Boston, .	612,580	90,951,800	151	96,422,800	157	5,471,000	-
Somerville,	72,540	6,301,000	89	6,548,400	90	247,400	-
Malden, .	39,820	2,000,100	51	1,857,100	47	-	143,000
Chelsea, .	88,650	8,694,000	97	3,761,000	97	67,000	-
Everett, .	31,350	2,441,600	81	2,555,000	81	113,400	-
Quincy, .	29,390	3,021,800	107	2,996,900	102	-	24,900
Medford, .	20,700	2,014,100	100	2,172,700	105	158,600	-
Melrose, .	14,870	1,591,800	109	1,748,000	118	156,700	-
Revere, .	. 14,0201	1,093,200	82	1,240,700	88	147,500	-
Watertown,	. 11,930	771,300	67	796,800	67	25,500	-
Arlington,	. 10,220	800,800	81	939,800	92	139,000	-
Milton, .	. 7,320	350,300	49	339,800	46	-	10,500
Winthrop,.	. 7,580	819,800	113	883,400	117	63,600	-
Stoneham,.	6,510	441,200	69	606,900	93	165,700	-
Belmont, .	4,560	272,900	62	<b>3</b> 31,100	73	58,200	-
Lexington,	. 4,420	335,000	79	324,000	78	-	11,000
Nahant, .	. 1,850	131,900	71	135,400	78	3,500	-
Swampscott,	6,420	492,500	79	475,800	74	-	17,200
District,	. 934,730	117,524,600	128	124,135,100	133	6,610,500	-

<sup>&</sup>lt;sup>1</sup> Includes 270 people in Saugus.

## The consumption in the several districts was as follows:—

•	Gallons per Day.	Increase (Gallons per Day).
Southern low service district, embracing the low service district of Boston, with the exception of Charlestown and East Boston,	50,973,100	3,203,300
Northern low-service district, embracing the low-service districts of Somerville, Chelsea, Malden, Medford, Everett, Arlington, Charlestown and East Boston,	28,069,200	1,811,000
Southern high service district, embracing the high service districts of Boston, Quincy, Watertown, Belmont, and a portion of Milton,	34,949,500	1,079,200
Northern high-service district, embracing Melrose, Revere, Winthrop, Swampscott, Nahant and Stoneham, and the high-service districts of Somerville, Chelsea, Malden, Medford, Everett and East Boston,	8,911,900	602,600
Southern extra high-service district, embracing the highest portions of West Roxbury and Milton,	595,600	50,800
Northern extra high-service district, embracing Lexington and the highest portions of Ariington,	635,800	84,800
Totals,	124,135,100	6,610,500

<sup>1</sup> Includes a small part of Saugus.

The increase of 6,610,500 gallons per day in the quantity of water used, as compared with the preceding year, was due, in a large degree, to the much colder weather during the months of January and February, resulting in a large waste to prevent freezing of water on premises of the water takers. The daily average consumption for the month of February was 146,118,200 gallons, equal to 158 gallons per inhabitant, or 22,766,500 gallons per day more than during the corresponding month in 1906. The reduction in the amount wasted from this cause, which is affected by the general use of meters, is well illustrated by comparing the per capita consumption in some of the municipalities where meters have been in use for several years with those where the water is paid for at schedule rates.

Consumption per Inhabitant in Gallons per Day.

		METERS IN G	ENERAL USE.			METERS NOT IN GENERAL			
		November, 1906.	February, 1907.			November, 1906.	February, 1907.		
Malden, .		48	52	Chelsea,		83	156		
Watertown,		69	61	Melrose,		101	125		
Milton, .		43	40	Revere,		68	₹11		
Belmont,		52	58	Winthrop,		98	129		

<sup>&</sup>lt;sup>2</sup> Decrease.

Another cause for the increase in the consumption of water during the year was the use for watering lawns and gardens during the dry weather in July and August. The increase from this cause was especially noticeable in the towns of Arlington and Belmont, where large quantities of water are used by market gardeners. The daily average consumption in Arlington for the month of August was 1,520,000 gallons, as compared with 775,800 gallons during the month of April, an increase of 744,200 gallons per day. The proportionate increase in Belmont was also very large, and there was a considerable increase throughout the suburban portions of the District.

In ten municipalities there was an increase and in five a decrease in the per capita use of water. In the town of Stoneham the per capita consumption rose from 69 gallons in 1906 to 93 gallons in 1907, an increase of nearly 35 per cent. As the increase in the night rate was approximately the same as the increase in the daily average, it is probable that the increase of 165,700 gallons per day was due to one or more leaks in the pipe system of the town. As a result of this increase the water assessment of the town will be increased about \$1,500 per annum during the coming year.

The diagram facing this page shows graphically the average rate of consumption in the district supplied by the Metropolitan Works for each week during the years 1906 and 1907, also the rate of consumption between the hours of 1 and 4 A.M., and the average temperature of air for the week.

The great increase in the use or waste of water during cold weather is well illustrated by comparing the lines showing the average weekly consumption in January, February, March and December, 1907, with those for the corresponding time in 1906. From the middle of January until the middle of March the temperature during 1907 was much lower than in 1906, the average for several weeks being from 10 to 20 degrees less, while the month of December was much warmer in 1907 than in 1906. As a result, the daily average consumption from January 12 to March 16 was 141,664,000 gallons in 1907, while it was only 120,885,000 gallons in 1906. For the week ending March 2 the daily average consumption was 154,500,000 gallons, or 30,364,900 gallons above the daily average for the year.

The number of new meters set during the past year in the cities

## AVERAGE RATE OF CONSUMPTION

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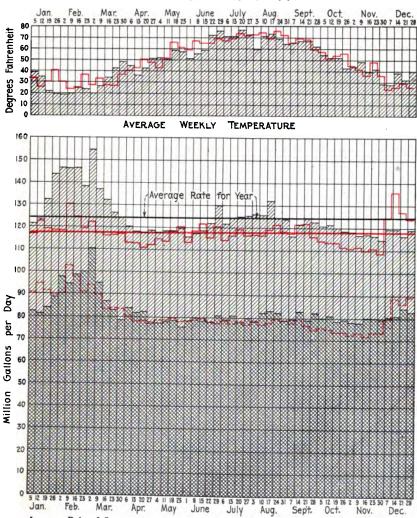
- IN --

# METROPOLITAN WATER DISTRICT

--- AND ---

# AVERAGE TEMPERATURE OF AIR AT CHESTNUT HILL RESERVOIR —FOR—

EACH WEEK DURING 1907





·•

and towns supplied from the Metropolitan Works was 4,334, or 77 more than during the previous year. The number of meters set in the different cities and towns, with the percentage of the total number of services metered at the end of the year, was as follows:—

CITY OR T	own.		Number added during 1907.	Per Cent. of Services metered Dec. 31, 1907.	CITY OR TO	WN.		Number added during 1907.	Per Cent. of Services metered Dec. 31, 1907
Boston, .			100	5.52	Arlington,		:	183	43.29
Somerville,		•	625	29.55	Milton, .			1	100.00
Malden, .			197	96.10	Winthrop,			25	3.37
Chelsea, .			849	27.14	Stoneham,	•		5	2.25
Everett, .			15	2.25	Belmont, .			38	100.00
Quincy, .			6 <b>4</b> 6	24.30	Lexington,			65	10.96
Medford, .			183	13.29	Nahant, .			17	21.95
Melrose, .			926	30.85	Swampscott,			416	68.25
Revere, .			80	5.57	Total, .			4,334	17.36
Watertown,			72	100.00					

The number of meters now in use in the several cities and towns is shown in Appendix No. 2, Table No. 38.

## QUALITY OF THE WATER.

The quality of the water supplied to the Metropolitan District has continued good throughout the year. The number of microscopic organisms has been smaller than during the two previous years and the color substantially the same.

Samples of the water have been collected monthly from 24 points, and semimonthly from 5 points on the works, and sent to the State Board of Health for chemical analysis. Samples of water have also been collected weekly at 35 points and biweekly at 8 points, and examined microscopically and for color, odor, taste and turbidity in the biological laboratory of the Metropolitan Water and Sewerage Board.

The following table gives a comparison of the average results of the examinations of water from a tap in Boston for the years 1900 to 1907, inclusive:—

•	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
State Board of Health Examinations.								
Color (Nessler standard),	0.24	0.24	0.26	0.25	0.231	0.241	0.24 1	0.22
Total residue,	3.80	4.43	3.93	3.98	3.93	3.86	3.86	3.83
Loss on ignition,	1.20 0.0012	1.64 0.0013	1.56 0.0016	1.50	1.59	1.59	1.39	1.40
Free ammonia,	0.0012							
Albuminoid am- total, dissolved.	0.0138							
monia /	0.0019							
	0.25	0.30	0.0020	0.30	0.34	0.0021	0.0020	0.002 0.33
Nitrogen as nitrates	0.0076							0.006
Nitrogen as nitrites,	0.0001					0.0001	0.0001	0.000
Oxygen consumed.	0.38	0.42	0.40	0.39	0.37	0.35	0.36	0.32
Hardness,	1.3	1.7	1.3	1.5	1.5	1.4	1.3	1.3
Metropolitan Water and Sewerage Board Examinations.								
Color (platinum standard),	34	34	33	35	32	28	25	27
Turbidity.	- T	2.0	2.3	2.2	2.4	1.9	2.2	2.2
Total organisms,	468							427
Amorphous matter,	97	38	34	36	36	37	42	47
Bacteria	181		164	126				176

NOTE.—Chemical analyses are in parts per 100,000, organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter. The standard unit has an area of 400 square microns, and by its use the number of diatomaceæ are decreased, and the number of chlorophyceæ and cyanophyceæ are very much increased, as compared with the number of organisms.

<sup>1</sup> Platinum standard.

In the biological laboratory there have been made 2,624 microscopical, 1,212 biological and 24 chemical examinations of water collected at various points upon the works. Of the microscopical examinations, 1,996 were of the regular weekly and biweekly samples, and 628 were special examinations.

The bacteriological work consisted of routine weekly examinations, monthly examinations of the main feeders of the Sudbury Reservoir, of Framingham Reservoir No. 3 and of Lake Cochituate, and monthly tests of the efficiency of the Pegan Brook, Marlborough Brook and Sterling filter-beds.

The organisms in the Wachusett Reservoir have been small in number and generally unobjectionable in character. A growth of Uroglena, which caused an objectionable taste and odor, was present in the water near the surface of the reservoir, in the vicinity of the dam, for about two weeks in June, but the water at a greater depth was not affected. The examinations made by the State Board of Health show that the color of the water and the quantities of both free and albuminoid ammonia were lower than during the preceding year.

The water in the Sudbury Reservoir, and in Framingham Reservoir No. 3, is largely supplied from the Wachusett Reservoir, and

like the water in that reservoir has been of better quality than in previous years. The number of organisms present in the water of both these reservoirs was less than for any year since 1904. Two growths of Uroglena developed in the Sudbury Reservoir, one in June and the other in November, the latter continuing to the end of the year, but the number of organisms present was not sufficient to cause objectionable taste and odor in the water delivered to the Metropolitan District.

In Lake Cochituate the number of organisms was larger than in any other source, with the exception of Whitehall Reservoir. Objectionable organisms were present nearly all of the time, and for about one-third of the year in sufficient numbers to make the water undesirable for use.

The organisms in the Ashland and Hopkinton reservoirs have been few in number and unobjectionable in character.

The water in the distributing reservoirs has generally been free from large numbers of organisms.

From May 27 to June 18 there was a large growth of Uroglena in the Waban Hill Reservoir, and growths of the same organism in the Mystic Reservoir made it necessary to shut that reservoir off from the pipe system from April 10 to 18.

#### SANITARY INSPECTION.

The sanitary inspection of the watersheds has been continued under the immediate supervision of William W. Locke, C.E., Sanitary Inspector.

On the Wachusett watershed 2 cases of typhoid fever were reported in Holden, 2 in Princeton, 1 in Sterling and 1 case of dysentery in Holden, as compared with 11 cases of typhoid fever during the previous year.

On the Sudbury and Cochituate watersheds 11 cases of typhoid fever were reported in Marlborough, 7 in Natick, 7 in South Framingham and 5 in Westborough, a total of 30, as compared with 44 during the year 1906.

There were no epidemics, and in 18 cases the patients resided in houses connected with the public sewers which discharge outside the watershed.

The sanitary conditions on the Wachusett watershed have been improved during the year by the demolition of 10 buildings on prop-

erty belonging to the Board, by the construction of 3 cesspools and 1 cemented brick privy vault in Sterling, by the completion of 2 acres of filter-beds, constructed for the purpose of purifying the water of the brook which receives unsanitary drainage from about 225 acres in Sterling, including the thickly settled portion of the town, and by the construction of 4 small sand filter-beds for purifying the drainage from 5 dwellings near the Sterling camp grounds.

On the Sudbury watershed 94 old and 7 new premises were connected with the public sewers which convey the drainage outside the watershed; 45 of these premises are in Marlborough, 52 in Westborough and 4 in Framingham.

On the Cochituate watershed 69 old and 19 new premises were connected with the public sewers; 41 of these are in Framingham and 47 in Natick.

At the request of the Board tight floors have been laid by the rail-road companies on the New York, New Haven & Hartford Railroad bridge crossing Framingham Reservoir No. 3, and on the Boston & Albany Railroad bridge over the Sudbury River just above Framingham No. 2, for the purpose of preventing direct pollution of the water from passing trains.

Considerable time has been devoted to inspection to prevent the pollution of the water supply by large gangs of men engaged in building and repairing State highways in Boylston, West Boylston and Holden, in widening and reconstructing Worcester Street between Framingham and Fayville, in widening the road-bed of the Boston & Albany Railroad between Natick and South Framingham, and in laying water pipes for the Westborough Insane Hospital in Crane Swamp.

A summary of the work of sanitary inspection for the year 1907 is given in the following four tables. The first table shows for the Wachusett watershed the number of premises inspected, the classification of cases inspected, and the condition of the premises at the end of the year; the second table gives the corresponding information for the Sudbury and Cochituate watersheds; the third table shows the improvements effected on the Wachusett watershed; and the fourth table the improvements effected on the Sudbury and Cochituate watersheds.

The headings of these tables are easily understood, except in a few instances: under the heading "Premises Vacant" are included all

cases which at present furnish no objectionable drainage, but which might furnish such drainage if the premises were occupied; under the heading "Unsatisfactory" are included all cases where there may be, under the most unfavorable conditions, wash from privies or direct sink drainage, all suspected cases, and all cases of manufacturing wastes entering feeders, even though there may be some attempt at previous purification.

In the third and fourth tables no cases are entered as remedied unless complete sewer connections have been made, or all probability of future contamination has been removed; and no cases are entered as partly remedied except where positive improvement in the sanitary condition has been effected.

Summary of Sanitary Inspections on the Wachusett Watershed in 1907.

				ises in-		CLA	881F1C	ATION	QF C	ASES I	N8PECT	ED.		CONDITION AT END OF YEAR.		
DISTRICT	·.			Number of Premises in- spected.1	Cesspools dug before 1907.	Cesspools dug in 1907.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.	Manure Piles.	Manufacturing Wastes.	Premises Vacant.	Satisfactory.	Unsatisfactory.	
French Brook,			•	66	30	1	-	_	-	10	33	-	5	63	3	
Muddy Brook,				32	9	ι	-	_ '	-	7	24	-	-	32	-	
Gates Brook,				138	89	6	-	-	-	4	58	-	8	136	2	
Malden Brook,				17	9	-	_	-	-	-	14	-	1	17	-	
Chaffin Brook,				160	72	6	-	1	-	13	77	1	14	148	12	
Asnebumskit Broo	ok,			281	147	10	5	8	24	25	96	2	10	239	42	
Muschopauge,				95	26	-	_	5	6	10	51	1	6	80	15	
South Wachusett I	Bro	ok,	•	82	22	1	2	1	4	3	36	-	10	74	8	
Trout Brook,				<b>3</b> 8	4	-	-	-	-	8	26	-	5	36	2	
East Wachusett B	roo	k,		210	62	1	2	8	7	23	109	-	7	186	24	
Stillwater River,				150	46	1	-	6	2	11	85	-	4	134	16	
Waushacum, .	•						-	4	1	8	60	-	9	150	14	
French Hill, .				28	15	2	-	-	-	-	15	-	4	28	-	
Totals, .	•	•	•	1,461	574	35	9	33	44	117	684	4	83	1,323	138	

<sup>&</sup>lt;sup>1</sup> On some premises there are 2 or more cases.

<sup>2</sup> Not including 204 summer cottages located near the Waushacum Lakes.

Summary of Sanitary Inspections on the Sudbury and Cochituate Watersheds in 1907.

	CLASSIFICATION OF CASES INSPECTED.										CONDITION AT END OF YEAR.	
DISTRICT.	Number of Prem spected.1	Cesspools dug before 1907.	Cesspools dug in 1907.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.	Manure Piles.	Manufacturing Wastes.	Premises Vacant.	Satisfactory.	Unastisfactory.
Sudbury Watershed.												
Farm Pond, Framingham Reservoir No. 3, Stony Brook, Angle Brook, Framingham Reservoirs Nos. 1 and 2, and Cold Spring	245 71 289 1,978	16 38 203 293	- 2 5 3	111	- 3 4	- 4 5	1 35 46 138	20 50 113 250	- - 1	6 1 17 67	243 67 268 1,908	2 4 21 70
Brook, Eastern Sudbury,	271 238 419 184 111 809	99 204 169 63 22 209	5 2 2 1 -	1111	2 2 2 3 1 1	7 3 1 6	105 46 166 77 74 89	112 43 83 53 37 128	1	27 5 61 32 11 51	261 226 386 157 100 792	10 12 33 27 11 17
Cochituate Watershed.			ŀ									
Snake Brook, Pegan Brook,	320 921 88 1,083 500	221 253 49 191 172	- - 2 -	-	2 - 4 8	3 4 - 3 7	93 77 29 88 36	68 110 41 183 49	1 - 3 -	8 29 8 16 8	296 893 86 1,036 478	24 38 2 47 22
Totals,	7,527	2,197	24	-	27	43	1,100	1,340	6	347	7,197	330

<sup>1</sup> On some premises there are 2 or more cases.

## Sanitary Improvements effected on the Wachusett Watershed in 1907.

	D	ISTRI	Remedied by Filter-bed.	Otherwise remedied. <sup>1</sup>	Partly remedied						
French Brook,					•				-	7	2
					•			.	-	-	-
Gates Brook,		•							-	_	-
Malden Brook,									-	_	-
Chaffin Brook.						•			-	-	_
Asnebumskit Bro	юk.								_	-	2
Muschopauge,	• '								-	2	_
South Wachusett	Bro	ok.			•				-	1	_
Frout Brook		• '							-	1	-
East Wachusett I	3roc	k.							_	_	-
Stillwater River.		٠.							-	-	-
Stillwater River, Waushacum, .									30	1	4
French Hill, .		•	•	•	•	•			-	-	-
Totals, .									30	12	8

<sup>&</sup>lt;sup>1</sup> Including buildings torn down or removed.

Sanitary Improvements effected on the Sudbury and Cochituate Watersheds in 1907.

Distr	ICT.					Remedied by Sewer Connection.	Otherwise remedied. <sup>1</sup>	Partly remedied.	Cesspools abandoned on Account of Sewer Connections.
Sudbury 1	Wate	rshe	d.						
Farm Pond,		•	•	•	•	3	-	-	3
Framingham Reservo	ir No	. 3,				-	-	2	-
Stony Brook,						-	-	5	-
Angle Brook,						39	1	3	25
Framingham Reservo	irs 1	los.	l an	d 2 s	ınd	-	1	5	_
Cold Spring Brook. Eastern Sudbury, .						-	2	2	-
Indian Brook, .						-	4	2	-
Western Sudbury, .						-	-	1	-
Whitehall Reservoir,						-	-	-	-
Cedar Swamp, .						52	2		49
Cochituate	Wat	ersh	ed.						
Snake Brook,						- 1	-	-	-
Pegan Brook, .						21	-	2	21
Course Brook, .						-	-	-	-
Beaver Dam Brook,						28	1	3	26
Dug Pond,						20	-	-	20
Totals,						163	11	25	144

<sup>&</sup>lt;sup>1</sup> Including buildings burned, torn down or removed.

#### SWAMP DITCHES AND BROOKS.

The drainage ditches in swamps on the several watersheds, aggregating 31.66 miles in length, not including those built during the past year, have been cleaned, and the weeds and brush mowed and burned for a width of from 10 to 20 feet on either side of the ditches. About 9,000 feet in length of the ditches on Angelico and Deerfoot brooks, near the Sudbury Reservoir, were repaired by repaving the slopes where the paving had been trampled out of place by cattle.

Beaver Dam Brook, which is one of the principal feeders of Lake Cochituate, runs through South Framingham and Natick for more than 2 miles with comparatively little fall, and there are obstructions in the channel which form pools in which objectionable matter collects during the summer when the flow of the brook is small. The brook was for much of its length bordered by a growth of shrubbery

which tended to conceal as well as to assist in catching matter which from time to time was thrown into the brook. During July and August all trees and shrubbery on both sides of the brook, for a distance of 10,000 feet, were cut. All débris, consisting of timber, roots of trees, old cans and objectionable matter of all kinds, was removed from the brook, and at several points deposits of silt, forming bars across the brook, were also removed. A survey of the brook from the Milford branch of the Boston & Albany Railroad to Lake Cochituate has been made with soundings to determine the depth of mud, for the purpose of preparing an estimate of the cost of more thoroughly improving existing conditions.

The work of draining the swampy land along the line of the Cochituate Aqueduct near Snake Brook, begun in 1906, was finished during the year. In order to prevent water from standing in a stagnant pool over the aqueduct, the ground has been raised for a distance of 800 feet, and a ditch 2,430 feet long built, of which about 900 feet were constructed during the past year.

The channel of Snake Brook for a distance of 850 feet easterly from the Natick and Cochituate Road has been much improved by constructing a channel 6 feet wide at the bottom, with side slopes of 1.5 to 1, both bottom and slopes covered with about 12 inches of gravel and paved with small stones, where necessary, to prevent wash-For a further distance of 1,050 feet, where the brook runs through clean gravel, the channel has been enlarged so as to have a bottom width of 4 feet, with side slopes of 1.5 to 1. In order to be able to prevent the use for pasturage of a considerable portion of the swampy land over the aqueduct, also of the land along the line of Snake Brook where the improvements above described have been made, 7.22 acres of land have been purchased, extending for 1,760 feet along the aqueduct line. Wire fencing, aggregating 1,233 feet in length, has been built to complete the enclosure of the land purchased, and 928 feet have been built alongside the new brook channel near the Natick and Cochituate road to prevent cattle from entering the brook.

#### FORESTRY.

At the Wachusett Reservoir the fire guard, 40 feet wide, along the margin of the land owned by the Board has been extended through timber and pasture land for about 2 miles in West Boylston, Boylston and Clinton, completing the guard around the entire limits of the Board's property on the margins of the reservoir.

The fruit and other undesirable trees have been cut on about 33 acres. An area of 20 acres was planted between May 7 and 18 with 26,000 two-year-old white pine seedlings, spaced in rows 6 feet apart each way. In 1906 there were planted on the Oakdale flats three groups of locusts, containing 100 trees each, and as these had largely failed they have been replaced.

The following table gives the information regarding land belonging to the Board around the reservoir, not including outlying land and land along the Quinepoxet River above the road which formerly crossed the river to the Harris Mills:—

				Acres.
Area of land which was forested when acquired,			1,483	
Area which has been planted with trees,				1,117
Area to be planted with trees,				315
Area open, which will probably not be planted, .				300
Area of marginal strip along shores of reservoir,			•	197
Total area,				3,412

At the beginning of the year there remained to be planted with arbor vitæ about 1½ miles of the reservoir margin. As the major part of this species of trees, planted along the reservoir margin in years past, has failed, further planting of these trees has been postponed until a stock of larger trees can be obtained from the nurseries.

The necessary care has been given to the Flagg and Lamson nurseries. There were transplanted from the nursery beds to the transplant rows at the Flagg nursery 285,550 white pines and 13,330 arbor vitæ. This nursery now contains the following stock, all in transplant rows: 363,540 white pines, 28,300 arbor vitæ, 4,380 Scotch pines and 3,140 white spruces.

Because of the failure of the greater part of the arbor vitæ planted along the reservoir margin in years past, it has been deemed advisable, in transplanting this species of trees, to transfer as many as possible to the Lamson nursery, where the soil is much better adapted for them. Ordinarily, trees in transplant rows are spaced 3 inches apart in rows 6 inches apart, but those transplanted during the past year have been spaced 6 inches apart in rows 12 inches apart, so as to allow of their attaining suitable size before being planted out in

the reservoir margin. There were transplanted in this manner from the Flagg nursery to transplant rows in the Lamson nursery 154,200 arbor vitæ.

Besides this stock, this nursery contains, in transplant rows, 13,550 sugar maples, 8,810 locusts, 3,090 white oaks, 3,000 ashes, 2,300 walnuts, 700 Norway spruces and 54 catalpas.

Over a considerable portion of land which was planted with white pines and has since been covered with a thick growth of white birches, briers and alders, or lots which were originally covered with white birches and underplanted with white pines, it has been found recessary to cut out all trees and brush which would interfere with the progress of the young pines. An area covering about 166 acres of land has been so cleared, at a cost of about \$7.85 per acre.

Fifteen acres of land on Nashaway Island, which is covered with a ten-year-old forest of white oaks, maples and walnuts, has been improved by thinning out the trees, at a cost of about \$31 per acre.

An area of about 13 acres of timber land, covered with chestnuts, pines and maples about thirty years old, has been improved in a similar manner, at a cost of about \$28.50 per acre.

A strip about 15 feet wide has been cleared on each side of brooksthrough forested marginal lands, having an aggregate length of about 5,700 feet.

The logs obtained in doing the foregoing work have been cut into lumber and cordwood, the quantities obtained being as follows:—

10,900 feet B M. hardwood dimension lumber;
4,100 feet B.M. applewood lumber;
455 cords of firewood.

Fifty-five cords of logs reported last year have been worked into lumber and are included in the above quantities.

All the above-mentioned work has been done by day labor, except the manufacture of the lumber, which was done at the saw mill of Lowe & Flagg in West Boylston.

At the Sudbury Reservoir 3,200 white pines were planted, a number of worthless apple trees cut down and either sold for firewood or burned, and a large quantity of brush remaining after the cutting of trees on Pine Hill was also collected and burned. Worthless apple trees were also cut on lands around Framingham reservoirs Nos. 2 and 3.

#### DISTRIBUTING RESERVOIRS.

The distributing reservoirs maintained by the Board are the Weston and Chestnut Hill reservoirs; the Waban Hill and Forbes Hill reservoirs and the Forbes Hill standpipe of the southern high-service system; Spot Pond and the Mystic Reservoir near Tufts College, of the northern low-service system; the Fells and Bear Hill reservoirs of the northern high-service system, and the Arlington standpipe of the northern extra high-service system.

#### Weston Reservoir.

The reservoir and the buildings and grounds about it are in good condition. In addition to the usual care required to keep the grounds in good order, a large amount of work has been done in protecting the trees and shrubs from the ravages of the gypsy and brown-tail moths. This has included not only the destruction of the moths, but also the cutting and burning of the underbrush and the cutting of all apple trees.

#### Chestnut Hill Reservoir.

This reservoir, with its gate-houses and grounds, including the grounds around the pumping stations, has received the usual care. The gravel walk around the reservoir has been resurfaced for a distance of 2,200 feet, and 650 feet of new walk, with 4 catch basins, have been built near the east end of the reservoir. The driveways in the vicinity of the pumping stations have been resurfaced at a cost of \$1,637.79. Repairs have been made upon the copper roofs on the terminal chamber and effluent gate-house No. 2, and the window grilles and woodwork painted.

A surface water drain in Reservoir Lane became clogged by gravel and other material during a storm in January, causing the water to overflow into the basement of the high-service pumping station. For the purpose of preventing this from recurring, a concrete catch basin, having a capacity of 9 cubic yards, was built at the entrance to the drain, at a cost of about \$350.

#### Waban Hill Reservoir.

The grounds have received the usual care, and the reservoir and grounds are in good condition.

## Forbes Hill Reservoir and Standpipe.

No other work than the usual care of the grounds and structures has been required at this reservoir. The standpipe has been in constant use, and the reservoir has been kept full of water and has not been drawn upon for the supply of the District.

## Spot Pond.

During the extreme cold weather in February and the early part of March sufficient water for the supply of the Metropolitan District could not be drawn through the aqueducts, and it became necessary to draw a portion of the supply from Spot Pond, thus lowering its surface about 3 feet. The pond was refilled in the middle of May, and remained practically full throughout the remainder of the year.

In connection with the work of destroying gypsy and brown-tail moths, which is described elsewhere in the report, considerable work has been done in cutting undesirable trees.

The stone dwelling house, on what was known as the Butterfield estate, has been destroyed.

The reservoir with its structures and grounds are in good order.

# Mystic Reservoir.

This reservoir has been in use throughout the year, with the exception of 18 days in April, when the water contained a growth of Uroglena which gave it an objectionable taste and odor.

The roof of the gate-house was painted, and both reservoir and grounds are in good condition.

#### Fells and Bear Hill Reservoirs.

The exterior wood and iron work of the gate-houses at both of these reservoirs was painted and the interior woodwork varnished.

# Arlington Standpipe.

This standpipe was painted in 1906 and has since required no attention other than occasional inspection.

## Mystic Lake.

The property here is in good condition. The club house of the Medford Boat Club was burned on January 28 and has since been rebuilt.

#### PIPE LINES.

In April a 6-inch connection was made at Washington Square in Chelsea, between the 20-inch Metropolitan main and the 10-inch main of the Chelsea pipe system. This connection is to be used only in cases of emergency. In October an 8-inch branch was placed in the 16-inch main opposite the Chelsea Reservoir, and a connection made with the pipes of the city of Chelsea, for the purpose of supplying water under higher pressure to the Soldiers' Home and a few houses in the immediate vicinity.

At the Arlington pumping station 171 feet of 16-inch and 175 feet of 20-inch pipe have been laid for the force and suction mains of the engines in the new station.

A 36-inch valve has been set in the 48-inch pipe line in Reservoir Lane, in Brookline, near the high-service pumping station.

Thirty leaks have been repaired on the pipe lines, at a cost of \$1,354.97. There were no breaks in the pipes during the year. Twenty-seven of the leaks occurred at joints, and fourteen of them were on the pipe lines crossing the Charles and Mystic rivers, where the changes in the length of the pipes, due to changes in temperature, draw the pipes apart and cause leaks at the tapered joints. A diver and dredge were employed three weeks, at a cost of \$1,081.39, in repairing nine leaks in the two lines of 36-inch pipes crossing the Charles River near Cottage Farm.

The ironwork of the bridges which support the pipes over the railroads at Walnut Avenue in Somerville, College Avenue in Medford, and Adams Street in Milton has been cleaned and painted, and the sheet lead, which is used to protect the bottom of the bridge girders from the engine gases, was replaced with thicker lead. Bridges over the Boston & Albany Railroad at St. James Street in Newton, and over the Fitchburg Railroad at Massachusetts Avenue in Cambridge, were cleaned and painted, and the bottom of the girders of the Massachusetts Avenue bridge was covered with lead.

A new floor was laid on the bridge over the Mystic River in Medford, and the railings were painted. This bridge not only supports two lines of pipe but is also used by the public as a foot bridge.

#### VENTURI METERS.

The throat of the 20-inch meter at the junction of the Arborway and South Street in West Roxbury has been enlarged from 6.5 inches to 8 inches on account of the increased consumption in the district supplied through the meter. A 16-inch meter with a 5.25-inch throat was placed in the force main leading from the new Arlington pumping station.

In order to prevent the freezing of the meter registers a non-conducting coating of pitch and granulated cork was placed around the upper part of five register chambers located at the junction of Highland Avenue and Clifton Street in Malden, at Jerome and High streets in Medford, near the East Boston pumping station, at the junction of Webster Avenue and Newton Street in Somerville, and at the junction of Blue Hill Avenue and Morton Street in West Roxbury, at an average cost of about \$62 each.

## PRESSURE REGULATORS AND RECORDING GAGES.

Pressure regulating valves have been continued in use during the year for reducing and regulating the water pressure in the pipes in Lexington, Winthrop, Swampscott and Nahant, also valves operated by floats for controlling the level of the water in the Revere and Chelsea reservoirs. They have been adjusted from time to time and, in general, control the pressure satisfactorily.

No changes have been made in the number of recording gages during the year, but one gage, formerly used in Nahant, has been transferred to the Water Department Office of the town of Winthrop.

The average maximum and minimum elevations of the water, due to the pressure at eighteen points in different parts of the District, as recorded by the gages, are given in Appendix No. 2, Table No. 40.

#### ELECTROLYSIS.

The electrical pressures between the pipe lines and street railway tracks were determined over the entire distribution system in March and April. Numerous measurements of the electrical pres-

sures on various portions of the system have also been made from time to time since the complete survey was finished. In general, the conditions, as shown by the surveys made in March and April, have not changed to any noticeable extent since last year, but there are indications of an increased rate of injury to the pipes from electrolysis during the past year on the northern high-service pipe line in Stoneham and on the supply pipe lines in Newton. Partial surveys made in October and November seem to indicate that the conditions are growing worse on the westerly 48-inch low-service pipe line between Chestnut Hill Reservoir and Spot Pond, and on the 42-inch low-service pipe line in Chelsea.

Twenty-four new gaging stations have been installed in order that more accurate determinations can be made of the currents flowing on the pipe lines. Measurements taken on the southern high-service 48-inch pipe line in Reservoir Lane in Brookline, about 300 feet from the high-service pumping station, at a time when the pipe line was cut for the purpose of setting a valve, showed that a current of electricity of from 45 to 75 amperes was flowing west on this pipe line toward the pumping station. A permanent gaging station has been established at this point so that measurements can be made from time to time in the future.

An insulating joint was placed between the northern high-service 20-inch pipe line and the Chelsea Water Works 10-inch pipe in Washington Square in Chelsea on April 18, when a connection was made between these two pipes. An insulating joint was also placed between the 48-inch low-service pipe line and the Malden Water Works 12-inch pipe line at the corner of Medford and Pearl streets in Malden, when changes were being made at that point on November 21. These joints were placed so that the flow of electricity between the Metropolitan pipe system and the local systems can be controlled, and the intensity and direction of the currents can be measured.

A comparison for the years 1906 and 1907 of the approximate average amount of electricity leaving the various pipe lines and flowing into the earth to cause damage to the pipes by electrolysis in the sections covered by our investigations indicate that the most serious injury is being done is as follows:—

DESCRIPTION OF PIPE LINE.	May and July, 1906, with Insulation Joints (Amperes leaving Pipes).	April, 1907, with Insula- tion Joints (Amperes
Easterly 48-inch low-service pipe line, Chestnut Hill Reservoir to Mal- den River.	75	70
Westerly 48-inch low-service pipe line, Chestnut Hill Reservoir to	137 1	105 2
Mystic River. 42-inch low-service pipe line in Cheises,	100	55 2
24-inch low-service pipe line across Chelsea Creek,	10	5
16-inch high service pipe line, Boston Avenue, Medford,	25	10
20-inch high-service pipe line, Stoneham,	20	25
20-inch and 12-inch high-service pipe lines in Lynn,	50	50
12-inch high-service pipe line, Hyde Park,	5	5
48-inch supply pipe line, Newton,	20	25

<sup>&</sup>lt;sup>1</sup> Insulation joint at Porter Square broken down.

Measurements made in November, between 4.30 and 6.30 p.m., which is the period when the travel on the street railways is heaviest, showed that the currents flowing on the pipes were then more than twice as large as the average current between 9.30 a.m. and 4.30 p.m. As it is impossible to take all of the measurements on even a single pipe line simultaneously, the foregoing figures are approximate averages only, because a street railway load is very changeable, and in some cases it has been necessary to adjust the various results in order to compare them.

The westerly 48-inch low-service pipe line between Chestnut Hill Reservoir and Spot Pond was uncovered at seven points in the vicinity of the Harvard power station during October and November, and was carefully examined to determine the extent of the damage Two of the excavations made on this line were from electrolysis. in North Harvard Street, 500 feet north of Western Avenue in Brighton, on pipe which had not previously been examined, because there was no indication that any appreciable damage was being done here until the electrical conditions were altered by setting insulating joints on this pipe line. About 300 square feet of pipe surface were examined and 28 small pits were found, none of them, however, being more than \( \frac{1}{8} \) of an inch deep. An examination was made of the pipe just south of and on the positive side of the insulating joint in North Harvard Street, about 200 feet south of the Charles River. On this pipe 150 pits about 3/4 of an inch in diam-

<sup>2</sup> Measurements made in October and November show much larger currents leaving this pipe line.

eter and not over \% of an inch deep, and 4 pits or patches about 75 square inches in area and not over \%\_6 of an inch deep, were found on 170 square feet of pipe surface. The pipe line had not previously been examined at this point. An insulating joint was set here in August, 1904.

The examination of the two lines of 36-inch pipe on the Boston shore of the Charles River, just above low-water line, showed that there were about 72 pits, from ½ to ½6 of an inch deep, in 300 square feet of pipe surface. Plaster casts were made of 4 of the larger pits. Two of the casts were taken of pits from which casts had been previously taken, in June, 1903, and a comparison of the casts shows considerable increase in area of pit and slight increase in depth.

Just north of and on the positive side of the insulating joint on Boylston Street at Charles River Road in Cambridge, and about 200 feet north of the Charles River, 200 square feet of pipe surface were examined, and about 80 good sized pits, from \(^1\)8 to \(^1\)6 of an inch deep, were found, and 4 plaster casts were made as permanent records of some of the larger ones.

At an excavation about 25 feet south of the south track at the car house on Boylston Street was found the most serious damage that has thus far been discovered on any of the pipe lines. On the bottom and near the bell end of pipe No. 432 there are 5 large pits in an area of 4 square feet of pipe surface. The combined area of the pits is about 11/3 square feet, and the iron was soft and disintegrated at these pits to a depth of from ½ of an inch to 1 inch. About 200 square feet of pipe surface were examined at this excavation, twofifths of which had been covered with asphalt and burlap since December, 1902. This covering was removed and a few drops of moisture, sufficient to stain blotting paper, were found under it. Quite a number of fair sized pits were found in the pipe under the covering, but a complete record of the condition of the pipe when covered in 1902 was not made, so that the changes that have taken place under the coating cannot be determined. Casts were taken as records of several of the larger and deeper pits. The total number of separate and distinct pits was 150. They varied from 1/8 of an inch to 1 inch in depth, and the skin of the uncovered portion of the pipe was soft all over to about ½ of an inch in depth. After the examination of the pipe was completed the Boston Elevated Railway Company recovered the portion which was formerly covered and painted the remainder of the pipe which had been exposed.

The insulating coating of asphalt and burlap was removed from pipe No. 780, under the car tracks opposite the car house on Boylston Street, and the pipe was carefully inspected. This pipe was discovered so badly pitted in December, 1902, when the insulating covering was first applied, that the 80 pits in it were carefully dug out and accurately located, and a plan of the outer surface was made for future reference. In April, 1904, the covering was removed from this pipe, and it was carefully examined, and the pits had then increased slightly in depth and considerably in area and number, as a total of 480 were located at that time. After the examination was completed, the Boston Elevated Railway Company recovered the pipe with asphalt and burlap. When examined during the past year the pipe was slightly damp in spots under the covering, and a total of 529 pits were found and accurately located. Of these, about 90 appeared to be new, and some of the old pits had enlarged in area, and in some cases 2 or more of the original pits had united to form a larger one. The depth of the old pits appeared to be only very slightly deeper than in 1904. Seven casts were taken as records of some of the larger and deeper pits, and are comparable with casts which were taken in 1904.

The examinations indicate that the portion of this 48-inch pipe line between Eliot Street in Cambridge and the south shore of the Charles River is in a dangerous condition.

An examination was made of about 150 square feet of pipe surface on the easterly 48-inch low-service pipe line in Middlesex Avenue at Eighth Street in Medford, just north of and on the positive side of an insulating joint located at this place. Thirty-four small pits and 2 distinct rings around the pipe were found, varying from ½ to ½6 of an inch in depth, indicating that disintegration of the pipe is going on slowly on the positive section of the pipe line. Three casts were taken as permanent records.

An examination of the 42-inch low-service pipe line in Broadway at Second Street, Chelsea, showed that the pits found at this place in August, 1903, had enlarged in area and increased slightly in depth. Twenty pits were found, varying from ½ to ¾ of an inch in depth, in an area of 50 square feet of pipe surface. Four casts were taken of the larger pits for comparison with casts made in

August, 1903. At the corner of Broadway and Williams Street about 150 square feet of pipe surface was examined on the 42-inch low-service main. The action at this point is quite uniform over the entire surface of the pipes. It was possible to cut into the pipe almost anywhere to a depth of ½ of an inch or more.

The 24-inch pipe in Broadway, south of Williams Street, is known to be in bad condition, but was not examined because it would have been necessary to disturb a new and expensive pavement which had been recently laid.

An examination was made of the 24-inch pipes crossing Chelsea Creek on December 18, and several casts were taken showing the condition of the pipes. The older pipe line is in a treacherous condition near low-water line, the material being very soft, so that it can readily be cut out to a depth of half an inch.

Measurements made during the year of the amount of electricity flowing on the pipes indicate that the disintegration of the 16-inch and 12-inch high-service pipe lines in Broad and Washington streets in Lynn is progressing at about the same rate as last year, but the pipes have not been examined because to do so it would have been necessary to disturb new and expensive pavements.

#### GYPSY AND BROWN-TAIL MOTHS.

The protection of the trees on the property of the Metropolitan Water Works from the ravages of the gypsy and brown-tail moths has required an expenditure of approximately \$10,700, which has been distributed as follows:—

Spot Pond,									<b>\$6,450</b>
Chestnut Hill Reserv	oir,								700
Weston Reservoir,									1,300
Mystic Lake, pumpin	g stat	tion a	and r	eserv	oir,				300
Sudbury, Cochituate	and V	Vesto	n aq	aedu	ets,				650
Lake Cochituate, .									500
Sudbury Reservoir,									250
Reservoirs in Framin	ghan	ı, As	hland	l and	Hop	kinto	n, .		50
Wachusett Reservoir	and A	Aque	duct,						500
		_							

\$10,700

The cost of work done at Spot Pond was about \$4,000 less than during the previous year, and it was also less at Mystic Lake, reservoir and pumping station, but on other parts of the works there was

an increase in cost, due to the spread of moths and to an advance of from 10 to 12½ per cent. in the rate of wages.

In the vicinity of Boston natural causes have reduced the browntail moths to a very small percentage of the number which infested the trees two years ago, while in Framingham, Southborough and Clinton they have increased in numbers. The thorough work of destroying the gypsy moths which has been carried on during previous years on the property of the Board at Spot Pond, and on lands in Medford, Arlington and Somerville, has resulted in reducing the number of these moths to comparatively small numbers, and the reduction in cost in 1907 will be followed by a still further reduction during the coming year. There has, on the other hand, been a large increase in the number of gypsy moths in Newton, Weston, Natick and Framingham, through which the aqueducts pass. The cost of protecting the 220 acres at the Weston Reservoir, and along the Weston Aqueduct between the reservoir and the terminal chamber, was about \$1,300, or more than double the amount expended in 1906. No gypsy moths have been found on Water Works property west of Framingham, but 9,500 nests of the brown-tail moths were destroyed at the Sudbury Reservoir, and the nests have been destroyed in considerable and increasing numbers at the Hopkinton Reservoir, along the line of the Wachusett Aqueduct in Southborough and Northborough, and in Clinton in the vicinity of the Wachusett Reservoir.

The methods employed for destroying and preventing the spreading of the moths have been as follows:—

At Spot Pond the egg clusters of the gypsy moths were painted during the winter with a mixture of creosote and fuel oil. During the latter part of April and the early part of May, 1,900 pounds of tanglefoot were used in banding the trees, at a cost, including labor, of about \$675. Lines of boards set on edge and smeared with tanglefoot, which had proved very effective in 1906, were placed along the lines of adjoining property where the moths were very prevalent. During June and July the trees on 23 acres were sprayed with arsenate of lead. The trees on the ground at Mystic Lake, Mystic pumping station and reservoir, and at the Chestnut Hill and Weston reservoirs, were treated in a similar manner. Along the line of the aqueducts and at Lake Cochituate the egg clusters of the gypsy moths were painted with creosote, and at Lake Cochituate 5,700 trees were

banded with burlap. More than 20,000 caterpillars were destroyed along the lines of the aqueducts, at Lake Cochituate and the reservoirs in Framingham, Southborough and Clinton.

Considerable work has been done, particularly along the lines of the aqueducts, in cutting underbrush and undesirable trees, as experience has shown that the suppression of the gypsy moth is very difficult wherever there is a thick growth of underbrush, and the unnecessary trees afford lodging places for the moths and increase the cost of maintaining the works.

#### CLINTON SEWERAGE.

The Clinton sewage disposal works were in daily operation throughout the year. The quantity of sewage pumped on the filter-beds was 867,000 gallons per day, an increase of 72,000 gallons per day over the preceding year, and of 123,000 gallons per day over the average since the plant was put into operation in 1899. This increase was due to leakage of ground water into the sewers during the months of October, November and December, when the rainfall was abnormally large. The daily average quantity pumped during these months was 1,161,000 gallons, as compared with a daily average of 528,000 gallons during the month of August.

Following are statistics relating to the operation of the pumping station:—

Daily average quantity of se	ewag	e pu	mped	(gal	lons)	,			867,0	000
Daily average quantity of co	oal c	onsur	ned (	poun	ds),				1,4	157
Gallons pumped per pound	of co	al,					•		ł	595
Number of days pumping,	•	•	•	•		•	•			365
Cost of pumping: —										
Labor,							•		<b>\$1,856</b>	76
Fuel,									1,470	05
Repairs and small supplies,		•					•	•	1,252	95
Total for station, .					•				<b>44,579</b>	76
Cost per million gallons pu	mpe	d,							<b>\$14</b>	47
Cost per million gallons rai									0	<b>28</b>

The cost of pumping was considerably in excess of that during any previous year, due to increased rate of wages, additional labor and fuel, due to shorter hours of labor and the larger quantity of sewage pumped, and to the cost of new pump plungers, diaphragms and valves. Repairs were made to the chimney of the pumping station in May, consisting of pointing, painting and oiling the brickwork, cleaning and painting the cast-iron cap and cleaning the interior.

#### Filter-beds.

The sewage was applied on the filter-beds in practically the same manner as during the preceding year until July 2, when, upon the recommendation of the Chief Engineer of the State Board of Health, radical changes were made in the method of applying the sewage, continuing to the end of the year.

The eight settling basins into which the sewage is pumped were used in rotation continuously throughout the year. During January, February and March the sewage was turned through one of the basins for two weeks, when it was drained off and another basin was used. During the remainder of the year, until December, two basins were used at a time for a period of one week, when they were drained and two others put into use; this method being adopted so as to decrease the velocity of the sewage while passing through the basins and thus increase the amount of sludge collected. During December two basins were used jointly for four weeks, then drained and two others put into use. By this method the eight basins can be used to care for the sludge during the winter, when it is impossible to clean them. The sludge accumulated in the settling basins has been given to the neighboring farmers, who are becoming from year to year more anxious to obtain this material for use on their farms.

Previous to April 19, at times when the temperature was below 15 degrees above zero, practically all of the sewage of each day's pumping was applied to one of five beds, which had been prepared with furrows 3 feet 6 inches apart, the average amount per application being 507,000 gallons, and each bed was used about once in nine days. When the temperature was higher than 15 degrees above zero the sewage was applied to the other or flat beds for about two and one-half hours, the amount per application being 313,000 gallons, and each bed was used about once in twelve and one-half days, which gives an average of about 25,000 gallons per acre per day. The amount of sewage applied to a bed at one time during this method of application varied with the severity of the winter from one and one-half hours to two and one-half hours. As the winter was very cold it was necessary when applying sewage to the flat beds to make the quantities large, in order to keep the beds open.

From April 19 to July 2 the sewage, after passing through the settling basins, was applied to one of twenty beds having an area of 1 acre for a little less than two hours, the amount of each application being about 215,000 gallons, and each bed was used about once in six days, the average rate being about 37,000 gallons per acre per day.

After July 2, when the recommendations of the Chief Engineer of the State Board of Health were put into effect, the sewage was applied to one of twenty beds having an area of 1 acre each for about thirty minutes, the time being so fixed as to use each bed every day, except as it had to be thrown out of service for weeding and cleaning. Under this method the amount per application was 64,000 gallons, and each bed was used about twice in three days, which gives an average of about 38,000 gallons per acre per day. At the beginning of freezing weather all of the twenty beds were prepared with furrows 3 feet 6 inches apart, and have been used on the half-hourly basis every day to the end of the year, without experiencing any trouble from freezing.

The results of the chemical analyses of the sewage and effluent are given in the following table:—

	1902.	1903.	1904.	1905.	1906.	January to June, 1907, inclusive.	July to December, 1907, inclusive.	Whole Year 1907.
Albuminoid ammonia, sew- age. Albuminoid ammonia, effu-	1.0517 .0891	.9233 .0782	.7967 .0686			i	.6883	.8442
ent Per cent. removed,	89	92	91	93	89	90.3	92.5	91
Oxygen consumed, sewage,	8.85	8.65	8.57	13.11	9.84	9.39	6.85	7.87
Oxygen consumed, effluent,	1.15	1.12	.99	1.126	1.34	1.40	.73	1.07
Per cent removed,	84	87	88	91	86	85.1	88.5	87
Free ammonia, sewage,	4.3284	3.8292	3.97	4.7533	3.5650	4.0550	3.6133	3.8342
Free ammonia, effluent, .	.6862	1.0185	.99	.9588	1.2723	1.6483	.9868	1.3176
Per cent. removed,	84	73	75	80	64	59.4	72.7	66
Nitrogen as nitrates, effluent,	.9815	.4168	<b>.4</b> 046	.2665	-1445	.0565	.2763	.1664

[Parts per 100,000.]

The changes which have been made in the methods of applying the sewage have, to a slight degree, improved the character of the effluent, and it is expected that under the present system the beds will gradually improve in efficiency. Under the direction of the Chief Engineer of the State Board of Health the experiments begun in 1906 have been continued, with a view to making further changes in the treatment of the sewage.

Devices for aerating the sewage as it leaves the settling basins have been placed in the outlet manholes. A wooden settling tank 2 feet deep, 12 feet wide and 42 feet long has been placed between the main effluent outlet and the small experimental filter, for the purpose of allowing the iron in the effluent to deposit in the tank before it reaches the experimental filter.

Six additional pipe wells have been placed over the filtering area for use in collecting samples of ground water, and 15 additional 2-inch tubular pipe wells have been driven for use in locating the water table in the filters and for collecting samples.

The small experimental filter, used for removing the iron from the effluent, was resurfaced twice with 6 inches of screened sand, and both the experimental filter and the settling tank have been covered so that they can be used during the winter.

The cost of maintaining the filter-beds, exclusive of the cost of the experimental work, which amounted to \$502.81, has been as follows:—

Labor,									<b>\$3,020</b> 78
Repairs and supplies,	•	•	•	•	•	•		•	34 40
Total,				•	•		•		\$3,055 18
Cost per million galle	ns t	reated,							<b>\$</b> 9 77

The cost of maintaining the beds has been considerably in excess of that of previous years, due to the increased rate of wages and changes in the method of operation.

Daily tests of the sewage and effluent, to determine the amount of dissolved oxygen and iron, have been made by the keeper in charge of the beds.

#### ENGINEERING.

A very large portion of the time of the engineering force is now devoted to matters pertaining to the maintenance and operation of the works. The more important of these matters are the superintendence of the operation of the Venturi meters and of the flow of water from the several reservoirs through the aqueducts; the determination of the quantities of water used in the several municipali-

ties; the tabulation of the records of rainfall as measured at twelve stations on the works, of the elevations of the several storage and distributing reservoirs, and of the pressures in the mains at different points in the Metropolitan District; the making of calculations to determine the yield of the several watersheds, the quantities delivered by the several aqueducts, the quantities pumped at the several pumping stations and the cost of pumping; the testing of coal and oil; and the examination of the pipes to determine the injury from electrolytic action.

Appended to this report are tables of contracts giving the amount of work done and other information, a long series of tables relating to the maintenance of the Metropolitan Water Works, tables showing the length of main pipes and number of service pipes, meters and fire hydrants in the Metropolitan Water District, and a summary of statistics for 1907.

Respectfully submitted,

DEXTER BRACKETT,

Chief Engineer.

BOSTON, January 1, 1908.

## REPORT OF CHIEF ENGINEER OF SEWERAGE WORKS.

#### To the Metropolitan Water and Sewerage Board.

Gentlemen: — The following is a report of the operations of the Engineering Department of the Metropolitan Sewerage Works for the year ending December 31, 1907.

#### ORGANIZATION.

The engineering organization during the year has been as follows:—

#### Division Engineers: -

FREDERICK D. SMITH, . In charge of maintenance and construction, South
Metropolitan System, in Quincy and Milton.

FRANK I. CAPEN, . . In charge of maintenance and construction, North

Metropolitan System and extension of the Highlevel Sewer in Brookline and Brighton.

SETH PETERSON, . In charge of construction, Section 80, including air tunnel, and of Section 81, South Metropolitan System.

In addition to the above, there were employed at the end of the year 24 engineering and other assistants.

#### METROPOLITAN SEWERAGE DISTRICTS.

#### Areas and Populations.

During the year no changes have been made in the extent of the sewerage districts. The area of the North Metropolitan District remains at 90.50 square miles, and of the South Metropolitan District at 100.87 square miles, — a total, inclusive of water surfaces, of 191.37 square miles. These districts include the whole or parts of 25 cities and towns, as set forth in the following table.

The populations in the table are based on the census of 1905.

Table showing Areas and Estimated Populations within the Metropolitan Sewerage District, as of December 31, 1907.

			Cr	CY O	в Точ	WN.						Area (	Square es).	Estimate latio	d Popu- on.
	Arlington,					•					•	5.20		10,840	
	Belmont,								•			4.66		4,630	
	Boston (porti	lone	of),						•			8.45		95,210	
	Cambridge,										•	6.11		100,740	
	Chelsea, .											2.24		88,940	
District.	Everett, .											3.34		81,840	
	Lexington,1											5.11		5,010	
넁	Malden, .											5.07		40,200	
Ē	Medford,						•					8.85		20,990	
큠	Melrose,											8.73		14,990	
!"	Revere, .											5.86		14,010	
	Somerville,	. ,	•									8.96		73,280	
•	Stoneham,											5.50		6,570	
	Wakefield.											7.65		10,850	
	Winchester.											5.95		8,850	
	Winthrop,											1.61		7,720	
	Woburn,		• .								٠.	12.71		14,470	
													90.50		498,6
	Boston (porti	one	of),						:			20.39		161,050	
	Brookline,											6.81		25,280	
	Dedham,1											9.40		7,880	
	Hyde Park,											4.57		15,080	
District.	Milton, .									•		12.59		7,440	
ă	Newton, .											16.88		38,660	
·	Quincy, .											12.56		29,890	
	Waltham,											13.63		27,720	
	TTP - 4 4	•	•		•		•	•	•	•	•	4.04	100.87	12,090	825,0
	Totals,												191.87	_	823.7

<sup>1</sup> Part of town.

#### METROPOLITAN SEWERS.

SEWERS PURCHASED AND CONSTRUCTED AND THEIR CONNECTIONS.

Within the Sewerage Districts there are now 98.8 miles of Metropolitan sewers. Of this total, 8.79 miles of sewers, with the Quincy pumping station, have been purchased from cities and towns of the districts, the remaining 90 miles of Metropolitan sewers and other works having been constructed by the Metropolitan boards.

The position, lengths and sizes of these sewers are given in the following tables, together with other data referring to the public and special connections with the system:—

North Metropolitan System.

		Jes.	\$ g .	SPECIAL CONNECTIONS.	=
CITY OR TOWN.	Size of Sewers.	Length in Miles	Public Connections, December 31, 1907.	Character or Location of Connection.	Operation.
Boston: — Deer Island, Fast Boston	6' 8" to 9',	1.867	4 28	Shoe factory,	-
Charlestown.	6' 7"×7' 5" to 1',	3.292	18 (	Navy Yard,	1 8 1 1 1
	9',	i	8	Club house	1
wimmiop,	• • • • • • • •	2.002	"}	Fire Dept. Station,	1
Chelsea,	8' 4"×9' 2" to 1' 10"×2' 4", .	5.128	9{	Rendering works, Metropolitan Water Works blow-off,	ī
Everett,	8' 2"×8' 10" to 4' 8"×5' 1", .	2.925	6	Metropolitan Water Works blow-off,	1 1 1
Malden,	4' 6"×4' 10" to 1' 3",	4.4981	26	Metropolitan Water Works blow-off,	1 29
Melrose,	4' 6"×4' 10" to 10",	6.099	84	Private buildings, 16 Factory, Railroad station,	1
Cambridge,	5′ 2″×5′ 9″ to 1′ 8″,	7.167	80	Slaughter-house,	1
Somerville,	8' 5"×7' 2" to 1' 10"×2' 8", .	3.471	10	Tannery, Slaughter-houses (8), Car-house, Streetrallway power house, Stable,	1 1 1 1 1 1
Medford,	4' 8"×5' 1" to 10",	5.859	20 }	Rendering works, Armory building, Private buildings, Stable, Tannery,	1 7 1 2 2 1
Winchester,	2' 11"×3' 3" to 1' 3",	6.428	18	Private buildings,	2 1 1
Stoneham,	1' 3" to 10",	0.010 0.938		Railroad station,	ī ī
	1' 6" to 10",		(		11ô
Arnugwu,	r o w w w ,	0.020	<b>]</b> "}	Car-house,	8

<sup>1</sup> Includes .988 of a mile of sewer purchased from the city of Malden.

<sup>\*</sup> Includes .786 of a mile of sewer purchased from the city of Melrose.

<sup>&</sup>lt;sup>3</sup> Includes 2.631 miles of sewer purchased from the town of Arlington.

#### North Metropolitan System — Concluded.

		iles.	nnec- ecem- 907.	SPECIAL	CONNECTIONS.	
CITY OR TOWN.	Size of Sewers.	Length in Mil	Public Conr tions, Dec ber 31, 19	Character or Conne	Location of section.	Number in Operation.
Belmont, <sup>1</sup> Wakefield, <sup>1</sup> Revere,		- 0.048 58.566	3 1 2	- -	= = =	396

#### South Metropolitan System.

			ا ا	Private house,	1
Boston (Back Bay),	6' 6" to 3' 9",	1.500*	9	Boston Park Department, . Simmons College buildings, .	1
Boston (Brighton),	5′ 9″×6′ 0″ to 12″,	4.1184	11	Art Museum,	3
Boston (Dorchester).	8'×4' to 2' 6"×2' 7",	2.8705	8	Machine shop,	1 1
Boston (Roxbury),	6′ 6″×7′, 4′ 0″,	1.430	-	Parental school,	-
hurv).		7.427	1 1	Lutheran Evangelical Church, Private buildings,	1 1
Brookline, Dedham,	6' 6"×7' 0" to 5' 6", 4'×4' 1" to 3' 9"×3' 10", 60" pipe,	1.435 2.350	2 5		=
	60" pipe,			Mattapan Paper Mills, Private buildings,	1
Milton,	11'×12' to 8", 4' 2"×4' 9" to 1' 8"	3.600	9	Private bundings,	2
Quincy,	$11' 3'' \times 12' 6''$ to 24" pipe, 3' 6" $\times$ 4',	6.580	4		=
Watertown,	4' 2"\xx4' 9" to 12",	0.7506	5	Factories,	2
		40.249	84	,	27

- <sup>1</sup> The Metropolitan sewer extends but a few feet into the towns of Belmont and Wakefield.
- <sup>2</sup> Includes 2.787 miles of Mystic River valley sewer in Medford, Winchester and Woburn, running parallel with the Metropolitan sewer.
  - <sup>8</sup> Includes .355 of a mile of sewer purchased from the city of Boston.
  - 4 Includes .026 of a mile of sewer purchased from the town of Watertown.
  - <sup>5</sup> Includes 1.24 miles of sewer purchased from the city of Boston.
  - 6 Includes .025 of a mile of sewer purchased from the town of Watertown.

#### COST OF CONSTRUCTION.

#### [To December 31, 1907.]

The cost of the 98.8 miles of Metropolitan sewers enumerated above, including seven stations, siphons and appertaining structures, may be summarized as follows:—

North Metropolitan System,					\$6,146,023 16
South Metropolitan System,					8,182,571 79

\$14,328,594 95

Information relating to areas, populations, local sewer connections and other data for the whole Metropolitan Sewerage District appear in the following table:—

#### North Metropolitan District.

Area (Square	Estimated Total	Miles of Local Sewer	Estimated Population	Ratio of Contributing Population	WITH	ions made Metro- Sewers.
Miles).	Population.	connected.	contributing Sewage.	to Total Population (Per Cent.).	Public.	Special
90.50	498,640	624.74	422,065	84.6	242	396
		South Me	etropolitan D	istrict.		<u> </u>
· · · · · · · · · · · · · · · · · · ·		1	<u>.</u>	1	I	<u> </u>
100.87	325,090	479.51	188,150	57.9	84	27
100.87	325,090	479.51	<u>.</u>	57.9	84	27

Of the estimated gross population of 823,730 on December 31, 1907, 610,215, representing 74.1 per cent., were on that date contributing sewage to the Metropolitan sewers, through a total length of 1,104.25 miles of local sewers owned by the individual municipalities. These sewers are connected with the Metropolitan System by 326 public and 423 special connections. It appears, also, that there has been during the year an increase of 42.19 miles of local sewers connected with the Metropolitan System, and that 7 public and 16 special connections have been added.

#### PUMPING STATIONS AND PUMPAGE.

The following table shows the average daily volume of sewage lifted at each of the six Metropolitan pumping stations during the year, as compared with the corresponding volumes for the previous year:—

								AVERAGE DAILY	Pumpage.	
Pun	LPING	Вта	TION.				Jan. 1, 1906, to Dec. 31, 1906.	Jan. 1, 1907, to Dec. 31, 1907.		e during Year.
						•	Gallons.	Gallons:	Gallons.	Per Cent
Deer Island, .			•		•		58,100,000	64,800,000	6,200,000	10.7
East Boston, .							56,100,000	62,300,000	6,200,000	11.1
Charlestown,							80,500,000	32,600,000	2,100,000	6.9
Alewife Brook,			•				3,451,000	4,123,000	672,000	19.5
Quincy,							8,528,000	8,615,000	87,900	2.5
Ward Street (act	ual	gallo	ns pt	ımpe	d).		20,800,000	21,200,000	400,000	1:9

#### CONSTRUCTION.

#### NORTH METROPOLITAN SYSTEM.

Extension of the Metropolitan Sewer in the City of Malden, (authorized by Chapter 319 of the Legislative Acts of 1906).

Section 64, Malden Extension.

Division Engineer in Charge. — Frank I. Capen. Contractor. — T. H. GIIL & Co.

At the beginning of the year the work was practically completed, as noted in the last annual report, except for minor repairs to surfaces in private lands and resurfacing of streets.

Sewage was turned into the section January 5, 1907, and since that date it has been in use as part of the North System.

About May 1, the necessary repairs were made over the line of the sewer in private lands, and the streets resurfaced and paved.

#### TIMBER BULKHEAD IN CHELSEA CREEK.

During the year a timber bulkhead has been constructed on the bulkhead lines of Chelsea Creek, at the northerly side of a lot on Chelsea Street near the Chelsea Street Bridge, East Boston, owned by the Commonwealth and occupied since its purchase as a site for locker and stable buildings for the North Metropolitan maintenance uses.

The lot as acquired included 52,000 square feet to the pier-head line of Chelsea Creek, as established by the United States Govern-

ment. Of this amount all but about 10,000 square feet was in tidal flats. The bulkhead as constructed encloses most of the flats. The lot when filled to the limits of the bulkhead will have an area of 38,600 square feet.

Permission for the construction of this bulkhead was granted by the Harbor and Land Commission May 17, 1907, under license No. 3172, and by the United States Government June 1. A contract for building this was made with Lawler Brothers July 16, 1907. Work was begun August 5, and completed September 3.

The bulkhead is of 4-inch hard pine, driven about 4 feet into the hard clay bottom of the creek, with spruce piles and spur shores, spaced 6 feet on centres.

The top of the bulkhead is about 6 feet above high water of the creek. The total length of bulkhead constructed was 359 feet. The tidal flats now enclosed by the bulkhead are being filled with ashes from the Metropolitan pumping stations and waste material deposited by the Boston street department. Approximately one-third the enclosed area is now filled to about the elevation of nearby streets.

#### SOUTH METROPOLITAN SYSTEM.

EXTENSION OF THE HIGH-LEVEL SEWER THROUGH WEST ROXBURY, BROOKLINE AND BRIGHTON.

This extension, authorized by chapter 406 of the legislative Acts of 1906, involves a length of 5.64 miles of main sewers, varying from 7 feet in diameter to 5 feet in diameter, and extending from Jamaica Plain, in West Roxbury, through Brookline and Brighton to Oak Square in Brighton, as outlined in detail in the last annual report.

For convenience in arranging contracts and records, this length has been divided into sections, numbered from 80 to 86, inclusive.

At the date of the last report construction was in progress on Section 80, located in West Roxbury. On account of its peculiarly dangerous character, construction on this section is being carried on by the Board by day labor, under direction of the Engineer.

During the year construction by contracts and day labor through West Roxbury, Brookline and Brighton, to within 2,500 feet of Oak. Square, has been in progress, involving what has been known as Sections 80 to 85, inclusive.



METHOD OF SUPPORTING ROOF PLATES IN TUNNEL HEADING—CONSTRUCTION BY COMPRESSED AIR ON HIGH LEVEL SEWER EXTENSION.





To date, 2.24 miles of this extension have been completed, and the sections now completed and under contract provide for about 4.25 miles. Section 86, near Oak Square, Brighton, it is anticipated will be placed under contract early in the coming spring.

Section 80, West Roxbury and Brookline.

Division Engineer in Charge. — Seth Peterson. Superintendent of Construction by Day Labor. — Charles A. Haskin.

This section extends from a branch in the existing bellmouth at the corner of Perkins and Day streets, along Perkins and Chestnut streets, in West Roxbury, passing Jamaica Pond, to a point in Chestnut Street about 15 feet beyond the Brookline town line, — a length of 3,123 feet.

The section is wholly in tunnel, at depths varying from 70 feet to 20 feet below the street surfaces. Passing Jamaica Pond the excavation is 35 feet below the ordinary water surface of the pond.

Owing to the peculiarly dangerous character of the work, it is being constructed by the Board by day labor and by pneumatic process, under the direction of Charles A. Haskin, pneumatic expert.

At the date of the last report a shaft leading down to the tunnel had been completed at a point 475 feet east of Jamaica Parkway, and tunnel headings had advanced about 70 feet both east and west from this shaft.

At the date of this report the east heading has advanced 1,230 feet from the shaft, and is now about 100 feet from the bellmouth at Center Street, which is to be the end of the section.

An air pressure from 6 to 8 pounds per square inch in excess of the atmospheric pressure has been maintained in this heading. For 600 feet the excavation has been in sand, gravel, quicksand and clay, with occasional boulders and short lengths of ledge. At this distance from the shaft solid ledge appeared in the bottom of the headings, and for a length of 150 feet the tunnel heading advanced into the sloping face of the ledge. At the distance of 800 feet from the shaft the excavation was in solid ledge of Roxbury pudding-stone, and has so continued for 425 feet, and will, doubtless, so continue to the end.

It is estimated the excavation will be completed in this heading about the middle of February, 1908.

To minimize the shocks from blasts on buildings near the line of the tunnel, the air pressure has been maintained in the heading while rock excavation has been in progress.

The average progress of the excavation has been 22 feet per week; the maximum progress of the excavation has been 41 feet per week; the average diameter of rock tunnel has been 10 feet.

The masonry lining of the tunnel has been completed in this heading to a point 885 feet from the shaft. The completed sewer is 7 feet in diameter, of circular cross-section, with not less than 12 inches in thickness of Portland brick walls.

In the solid ledge the masonry lining has not been placed. It is anticipated that this will be of concrete and will be completed as early as May 1, 1908.

The westerly heading has advanced at the date of this report 1,330 feet from the shaft, and about 520 feet remain to be completed. It is probable that this will be completed as early as May 1, 1908. The excavation has been through fine sand, coarse gravel and quick-sand, in alternate layers, with occasional boulders. An air pressure of about 6 pounds per square inch in excess of atmospheric pressure was maintained in this heading near the shaft, gradually increasing to 12 pounds near Jamaica Pond at the end of the year. Average progress of excavation, 24 feet per week; maximum progress of excavation, 42 feet per week.

The masonry lining in this heading has been completed to the end of the heading. The sewer is 7 feet in diameter, with not less than 12-inch Portland brick walls.

The total weekly progress for the whole section has been: average per week, 46 feet; maximum per week, 83 feet.

#### Section 81, Brookline.

Division Engineer in Charge. - SETH PETERSON.

Contractors. — Bruno & Petitti, Contract No. 60 (Sta. 0 to 21+40). Hugh Nawn Contracting Company, Contract No. 61 (Sta. 21+40 to 34+15).

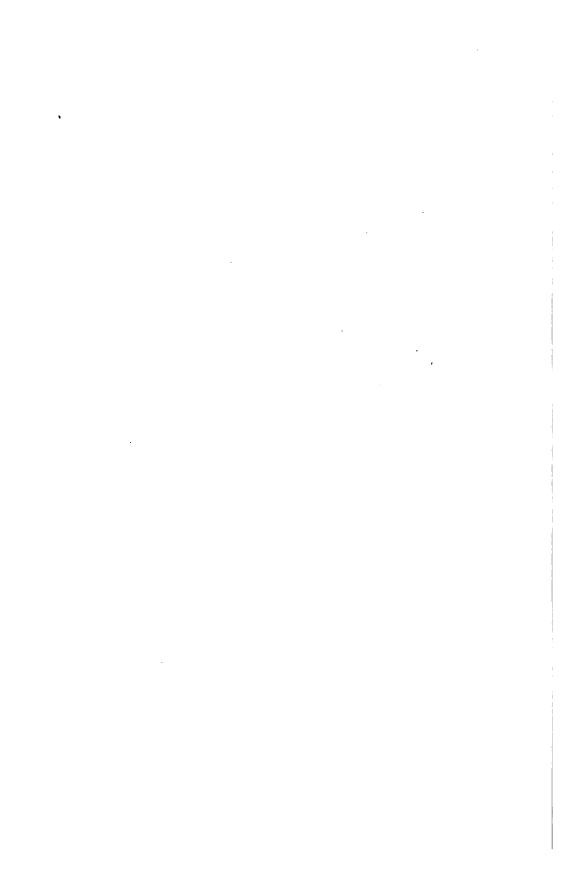
This section extends from near the town boundary line of Brookline, at Chestnut Street, along Chestnut, Kendall and Cypress streets, to Boylston Street in Brookline, — a distance of 3,415 feet.

Two contracts have been made for this construction, one extending from the town line along Chestnut and Kendall streets, a distance of 2,140 feet, with Bruno & Petitti. The sewer for this length is lo-



AIR LOCK AT TUNNEL HEADING-CONSTRUCTION BY COMPRESSED AIR ON HIGH LEVEL SEWER EXTENSION.





cated about 20 feet to its water line below the street surface. The excavation is expected to be largely in sand, gravel and clay, with considerable water.

The contract was made November 27, 1907. On account of the severe weather of the winter, the Board permitted the contractor to delay starting on this work until March 1, 1908.

A second contract, extending from Kendall Street, through Cypress Street, to Boylston Street, a distance of 1,275 feet, was made with the Hugh Nawn Contracting Company on November 25, 1907. Of this length, 940 feet will be in tunnel, in earth and Roxbury puddingstone, and 335 feet in open trench. Work in the open cut section was started December 2, 1907, on the south side of Boylston Street. At the date of this report 130 feet of trench have been excavated to grade. The excavation at this location has a depth of about 25 feet, — 20 feet in sand, gravel and clay. The bottom 5 feet is in Roxbury pudding-stone. The excavation has been handled by bucket excavators. Considerable water has been found in excavation.

A shaft about 12 feet square for tunnel heading was started December 5, 1907, at the corner of Kendall and Cypress streets. At the date of this report the shaft has been completed to a depth of about 35 feet, and a tunnel heading started in a northerly direction.

The sewer along the whole length of this section is to be of horse-shoe cross-section, 7 feet high and 6 feet 6 inches wide. The masonry walls of the sewer are to be of Portland concrete, from 12 inches to 15 inches in thickness. At the date of this report no masonry has been placed in the section.

#### Section 82, Brookline.

Division Engineer in Charge. - Frank I. Capen.

Contractors. — T. J. O'CONNELL, Contract No. 57 (Sta. 0+30 to 13+50). T. J. O'CONNELL, Contract No. 55 (Sta. 30+50 to 48+50). James Driscoll & Son, Contract No. 56 (Sta. 13+50 to 30+50).

This section extends from Boylston Street, along Cypress Street, Brington Road, private lands, Brookline Playground, Davis and Gorham avenues, Greenough, Washington and Park streets, to Beacon Street, — a distance of 4,830 feet.

Three contracts have been made for this construction; one extending from Boylston Street to Davis Avenue, with T. J. O'Connell, dated July 9, 1907, for a length of 1,320 feet. Work on this con-

tract was begun July 18, at Davis Avenue. The excavation had an average depth of 18 feet, in sand, gravel and clay. In the Brookline Playground, for a length of about 200 feet, very fine sand was encountered. Not a large amount of water was found in the excava-It was handled by a 4-inch centrifugal pump, electrically operated at a well on Davis Avenue. This pump controlled the ground waters to the crossing of the Boston & Albany Railroad. The excavation was handled by bucket excavators from Davis Avenue to the railroad. The excavation under the railroad and Village Brook was made without the aid of machinery. Through private lands and Brington Road the excavation was handled by bucket excavators, to near Cypress Street. In Cypress Street and for a short length in Brington Road, Roxbury pudding-stone was found for a depth of about 6 feet at the bottom of the trench. This rock excavation was found for a length of about 150 feet, and over this length of trench the excavation was handled by a framed derrick on platform.

No large amount of water was found in the excavation between Boylston Street and the railroad. It was handled from a well on private lands near Brington Road by a 4-inch centrifugal pump, electrically operated. The excavation on this length of the section was completed about the middle of December.

The sewer for this length is 6 feet 6 inches wide and 7 feet high, of horseshoe cross-section. It is built of Portland concrete, with walls about 12 inches in thickness. Passing under the branch of the Boston & Albany Railroad the masonry was increased to about 16 inches in thickness and reinforced with twisted steel. Passing under Village Brook the section was widened to 8 feet and the arch depressed so that the sewer had a height of 5 feet and 6 inches. The walls of the sewer were increased to 16 inches in thickness and the section reinforced with twisted steel.

For a length of about 100 feet, in Brington Road, the local 8-inch sewer was relaid on the side of the Metropolitan Sewer. The masonry was completed on this contract and trenches backfilled late in December. On account of the severe winter conditions, repairs to surfaces of streets and in private lands will be made in the spring.

A second contract, for construction of part of this section, was made with James Driscoll & Son, on May 21, 1907, for a length of 1,700 feet, in Gorham Avenue, Greenough and Washington streets,



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TRENCH MACHINE IN OPERATION ON CYPRESS STREET, BROOKLINE-HIGH LEVEL SEWER EXTENSION.



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from Davis Avenue to Park Street. Work on this contract was begun June 4, 1907, at Davis Avenue. The excavation had an average depth of 22 feet, with a maximum of 26 feet in Greenough Street. For a length of about 400 feet in Greenough Street the excavation was in hard, compact gravel and clay. On the remainder of the contract the excavation was in clean sand and gravel of such character that it was used in the masonry of the sewer. But very little water was found anywhere in the section; such as was found was handled in a well at Davis Avenue, and lifted by a 4-inch centrifugal pump, electrically operated, the same as used by T. J. O'Connell, before noted. The excavation throughout practically the whole contract was carried out by bucket excavators. The excavation was completed about December 1. For a length of 30 feet near the corner of Greenough Street and Gorham Avenue, passing an elm tree of great size, the excavation was in tunnel.

The sewer for the 1,700 feet of this contract is of horseshoe cross-section, 6 feet 6 inches wide and 7 feet high. The invert is built entirely of Portland concrete, with walls about 12 inches in thickness. The arch is of Portland brickwork, 8 inches thick, reinforced with concrete spandrels for about three-fourths its height. Passing under a brick sewer of the town of Brookline, at the corner of Washington and Park streets, the masonry section of the sewer was increased to 8 feet in width and the arch depressed to 5 feet and 6 inches in height. The walls of the concrete invert in the modified section were about 16 inches in thickness and the brick arch 12 inches. This section was further reinforced with twisted steel rods.

Work on this contract was completed at the date of this report, except for repairs to street surfaces and sidewalks, which, owing to frozen winter conditions, will be delayed until spring.

A third contract for construction on this section was made with T. J. O'Connell on May 29, 1907, for a length of about 1,800 feet in Park Street, from Washington Street to Beacon Street. Work on this contract was begun June 8. The excavation was in dry sand and gravel, with an average depth of 24 feet and a maximum depth of 28 feet near Beacon Street. The excavated material was of such character that it was used in the masonry of the sewer. The excavation was handled for practically the whole contract by bucket excavators of the cableway type. The excavation was practically dry.

westerly through Winchester Street, beyond Thorndike Street, thence in private land to a point near Columbia Street. Work on this section was begun April 23, 1907, at a shaft about 12 feet square, in private land near Columbia Street, 23 feet from the end of the section.

The excavation of this shaft was about 30 feet in depth, in sand, gravel and clay, and was completed May 11, 1907. Headings were started from this shaft in an easterly direction towards Columbia Street May 13, and completed May 17.

A heading was started in a westerly direction towards Winchester Street May 20, 1907, and extended to a point 327 feet beyond the shaft. This heading was completed September 3.

A second shaft, about 12 feet square, located on Winchester Street, about 45 feet north of Fuller Street, was started April 29, 1907. The excavation was in sand, gravel and clay to a depth of 45 feet, and was completed May 15.

A heading extending northerly along Winchester Street from this shaft was started May 30, 1907, and was completed to a point 406 feet from this shaft on August 13. A heading south from this shaft was started September 16 and extended to a point 33 feet from the shaft on September 19.

The excavation in the tunnel heading was in sand, gravel and clay, with a small amount of water, lifted by 2-inch piston pumps in the shafts. The excavated material was lifted by small derricks at the shafts.

For a length of 200 feet, about midway between the shafts, boulders of large size were encountered in the headings. The tunnel heading was about 9 feet high and 9 feet in width, involving about 3 cubic yards of excavation per linear foot. The headings were sheathed with 2-inch lagging, with posts and caps 4 feet 6 inches apart.

The completed sewer is 5 feet 9 inches wide and 6 feet in height. The masonry walls of the sewer are of concrete and the tunnel headings, as outlined above, are of such dimensions as to yield not less than 12 inches of concrete at any point.

The placing of this concrete began July 3, 1907, and was completed November 15. The shaft near Fuller Street has not been filled to date but is still in use by other contractors on other portions of the section. The shaft on private lands near Columbia

Street was filled about December 1. The masonry of the sewer was built across the shaft, and the arch reinforced to a depth of about 3 feet with concrete.

A second contract for a portion of this section in Beacon and Winchester streets, between Park Street and Fuller Street, was made with T. J. O'Connell November 26, 1907, for a length of 1,664 feet. A shaft in Beacon Street, at the end of the section, about 12 feet square, for tunnel heading, was started December 4, and completed December 9, to a depth of about 30 feet. A tunnel heading was started in a northerly direction December 10. At the date of this report about 66 feet have been excavated in dry sand and gravel.

A shaft in Winchester Street, about 800 feet north of Beacon Street, was started December 5, 1907, and completed December 17, to a depth of about 32 feet; the shaft is 12 feet wide and about 16 feet in length.

A heading northerly from the shaft was started December 19, 1907, and at the date of this report has advanced about 30 feet. A southerly heading was started December 19, and driven about 30 feet at the date of this report. The excavated material in both headings was sand and clay with considerable water. Work was begun December 4 on the extension of the heading southerly from a shaft near Fuller Street, left by Charles G. Craib & Co., before noted. About 25 feet of excavation have been completed in the heading in sand and clay. A small amount of water has been found in the heading. The headings are about 9 feet high and 9 feet wide, sheathed with 2-inch plank, with posts and caps about 4 feet 6 inches apart. About 50 feet of the masonry lining of the tunnel have been placed.

The completed sewer is 6 feet high and 5 feet 9 inches wide; the masonry is of Portland concrete and the walls are not less than 12 inches in thickness.

Section 84, Brookline and Brighton.

Division Engineer in Charge. — Frank I. Capen. Contractor. — D. F. O'Connell, Contract No. 53.

This section extends from near Winchester Street, through private lands and Columbia Street in Brookline, and in Harlan Street, private lands and Commonwealth Avenue in Brighton, to near Allston Street,—a distance of 2,168 feet.

The contract for the construction was made with D. F. O'Connell,

dated April 9, 1907. Work on the contract was begun April 23, in private land near Columbia Street. The excavation had an average depth of 16 feet, largely in sand, gravel and clay. Between Station 3+01 and Station 6+15, passing a pocket of peat, the sewer was supported on concrete piles 12 inches square, reinforced with four 3/4-inch square steel rods. The piles were made in forms on a platform outside the trench, and when thoroughly hardened were driven with an ordinary drop-hammer pile driver. Where the pile foundation was placed, the sewer was further strengthened by Ransome twisted steel bars, 3/4 of an inch square, laid longitudinally in the arch, sidewalls and invert of the sewer, about 18 inches centre to centre. Three twisted steel rods 3/4 of an inch square were placed over each pile bent.

No large amount of water was found in the excavation. It was handled from a well in Columbia Street, near the lower end of the section, by a 4-inch centrifugal pump, electrically driven. For a length of about 830 feet in Columbia Street an 8-inch local sewer, with branches every 25 feet, was laid on the side of the Metropolitan Sewer to provide for the sewage of that side of Columbia Street, cut off from the existing local sewer by the Metropolitan Sewer. From Kenwood Street to near Columbia Place and southerly on Russell Street from Columbia Street about 330 feet the street grades were raised a maximum of about 3 feet. The surplus earth from the excavation was used in filling these streets, under an agreement with the town of Brookline.

The excavation of this section was completed about the middle of November. The sewer for this section is 5 feet 9 inches wide by 6 feet high, of horseshoe section. It is built of Portland concrete, with the wall about 12 inches in thickness. The masonry was completed and the trench backfilled about the first of December. For a length of about 120 feet at the end of the section the excavation was in slate rock at an average depth of 17 feet below the surface.

#### Section 85, Brighton.

Division Engineer in Charge. - Frank I. Capen.

Superintendent of Construction by Day Labor. — Chas. A. Haskin (Sta. 0 to 11+42).

Contractors. — Geo. M. Beyne Company, Contract No. 63 (Sta. 11+42 to 24+00). D. F. O'Connell Co., Contract No. 64 (Sta. 24+00 to 47+00). Hugh Nawn Contracting Company, Contract No. 65 (Sta. 47+00 to 63+50).

This section extends from near Allston Street, along Commonwealth Avenue, Warren, Cambridge and Washington streets, to near Lake Street, — a distance of 6,350 feet. The lower portion of this section was constructed by the Board by day labor. Three contracts have been made for the construction of the remainder of the section.

Work was begun by the Board January 5, 1907, at a shaft about 12 feet square, in Commonwealth Avenue, near Allston Street. The excavation of this shaft was about 40 feet in depth, partly in sand, gravel and clay and partly in rock, and was completed February 22. A heading was started from this shaft in a westerly direction towards Warren Street February 23, and extended to a point 548 feet beyond the shaft. This heading was completed August 14.

A heading was started in an easterly direction towards Allston Street February 23, 1907, and extended to a point 601 feet beyond the shaft. This heading was completed August 7.

The excavation in the tunnel headings was largely in rock. For a distance of about 200 feet near the shaft disintegrated slate was encountered. The remainder of the rock excavation was in sandstone. For a length of about 300 feet, at Allston Street, the excavation was wholly in clay. A small amount of water was found and lifted by a small piston pump in the shaft. The excavated material was lifted in buckets at the shaft and conveyed to a rock crusher where the more suitable rock was crushed for concrete purposes. The tunnel headings were about 9 feet high by 9 feet in width, involving about 3 cubic yards of rock excavation per linear foot. A portion of the arch of the east heading farthest from the shaft required timbering, to retain loose, disintegrated rock.

The completed sewer is 5 feet 9 inches wide and 6 feet in height. The masonry walls of the sewer are of concrete, and the tunnel headings are of such dimensions as to yield not less than 12 inches of concrete at any point. The placing of this concrete in the east head-

ing began August 10, 1907, and was completed November 16. The concrete in the west heading was placed between August 15 and October 23. A manhole was constructed in the shaft and the shaft was completely backfilled about December 1.

A contract for a portion of this section in Warren Street was made with the George M. Bryne Company, dated November 27, 1907, for a length of 1,252 feet. At the date of this report the contractor's operations have been confined to erecting plant and necessary building for his machinery.

A contract for a portion of this section in Warren, Cambridge and Washington streets was made with the D. F. O'Connell Company, dated November 25, 1907, for a length of 2,300 feet. A shaft about 12 feet square for tunnel headings was started December 11, on Cambridge Street at Elko Street. At the date of this report this shaft has been excavated to a depth of about 38 feet.

The contract for the portion of this section in Washington Street was made with the Hugh Nawn Contracting Company, dated November 25, 1907, for a length of 1,650 feet. A shaft about 12 feet square for tunnel headings was started December 2, on Washington Street, 200 feet west of Foster Street. At the date of this report the shaft has reached a depth of about 42 feet.

The sewer involved in these three contracts is to be of horseshoe cross-section, 6 feet high and 5 feet 9 inches wide. The masonry walls of the sewer will be of Portland concrete not less than 12 inches in thickness. At the date of this report no masonry has been placed under any of these contracts.

#### Additional Pumping Plant at Quincy Station.

The two new horizontal tubular boilers and the 10,000,000-gallon Lawrence centrifugal pump and engine described in last year's report in course of installation were completed March 1, 1907. Capacity and efficiency tests indicate that the plant fully satisfies the guarantees of the builders.

This addition to the pumping plant of this station has been used during periods of flood and has given very satisfactory results.

#### MAINTENANCE.

#### SCOPE OF WORK AND FORCE EMPLOYED.

The maintenance of the Metropolitan Sewerage System includes the operation of seven stations and 98.8 miles of Metropolitan sewers, receiving the discharge from 1,104.25 miles of town and city sewers at 326 points, together with the care and study of inverted siphons under streams and in the harbor.

The permanent maintenance force of 140 men includes 83 engineers and other employés at the pumping stations, and 57 men employed on actual sewer maintenance and care of pumping station grounds. In the three following tables the use of the completed systems and other data are shown:—



# NORTH METROPOLITAN SYSTEM.

Table showing Cities and Towns delivering Sewage in this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1907.]

Ratio of Contributing Area ing Area to Ultimate Area.	Per Cent. 76.4 471.8 483.8 483.8 483.8 683.8 882.8 882.8 882.8 883
Ratio of Contributing Population to Present Total Population.	Per Cont. 1992
Area ultimately to contribute Sewage.	Bquare Miles. 1.61 2.18 2.18 2.24 3.24 3.34 3.34 3.34 1.27 1.27 1.27 1.27 5.50 5.50 5.50 5.20 5.20 6.11 6.11
Estimated Area now contributing Bewage.	Square Milos. 1.08 1.08 1.08 1.08 1.08 1.08 0.07 4.94 8.28 8.28 8.28 1.09 0.97 0.97 0.97 0.97 2.88 2.88
Estimated Present Total Population.	1,130 # 7,730
Estimated Population now con- tributing Sewage.	1,180 : 7,1440 84,650 85,680 11,106 83,880 11,106 11,610 1
Estimated Number of Persons served by Each House Connection.	884 644 644 644 644 644 644 644 644 644
Number of Con- nections with Local Sewers.	1,983 4,108 4,5504 4,5504 4,500 4,500 1,520 1,630 1,03
Separate or Combined.	Separate, Separate, Separate, Separate and combined, Separate and combined, Separate, Separate, Separate, Separate, Separate, Separate, Separate and combined, Separate and combined, Separate and combined, Separate,
Miles of Local Sewer connected.	2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.2 2.7.3 2.3 2.3 2.3 2.3 2.3 2.3 2.3 2.3 2.3 2
CITIES AND TOWNS.	Boston (Deer Island), Winthrop, Boston (East Boston), Gleislea, Evereit, Malden, Malden, Melrose, Boston (Charlestown), Gambridge, Boston (Charlestown), Wholbester, Womerville, Wholbester, Woburn, Somerville, Watefield, Arlington, Refere, Totals,

<sup>1</sup> Estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1905 extended to May 1, 1907.
<sup>2</sup> Estimated by Superintendent Jas. H. Cronin of the Institution on Deer

jsland,
The districts connecting at Cypress Street, Revere Beach Parkway, Spring-vale Avenue, Willoughly, Beilingham, Highland, Hawthorn and Spruce streets are now contributing sewage.

Estimated.

Revised in accordance with recent report of the City Engineer.

Exclusive of Mystic River valley sewer and tanneries.

Including 2 connections with McLean Hospital, baving an estimated population of 500.

9 Lexington not connected.

## SOUTH METROPOLITAN SYSTEM.

Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Con-Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and tributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations estimated as of December 31, 1907.]

CITIES AND TOWNS.	Miles of Local Sewer connected.	Separate or Combined.	Number of Con- nections with Local Sewers.	Estimated Number of Persons served by Each House Connection,1	Estimated Population now con- tributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contribut- ing Area to Ultimate Area.
Boston (Back Bay), .	22.36	Separate and combined.	1,549	18.0	27,920	28,050	Square Miles.	Square Miles.	Per Cent. 99.5	Per Cent.
Boston (Brighton), .	53.79	Separate and combined,	2,724	6.1	16,615	24,130	3.16	8.74	68.9	84.5
Brookline,	62.89	Separate and combined,	3,256	7.5	24,420	25,280	3.25	6.81	98.6	1.74
Newton,	103.35	Separate,	5,315	5.9	31,360	38,660	6.90	16.88	81.1	40.9
Watertown,	33.39	Separate,	1,690	5.3	. 096'8	12,090	1.86	4.04	74.1	46.0
Waltham,	42.38	Separate,	3,287	7.8	25,600	27,720	2.19	13.63	98.4	16.1
Boston (Dorchester), .	32.38	Separate and combined,	2,086	6.7	13,980	46,600	1.55	4.89	30.0	81.7
Milton,	7.53	Separate and combined,	211	5.2	1,095	7,440	0.39	12.59	14.7	3.1
Hyde Park,	22.97	Separate,	1,130	7.92	8,925	15,080	1.16	4.57	2.69	25.4
Dedham,	14.30	Separate,	392	0.9	1,960	7,880 8	0.72	9.40	24.9	7.7
Boston (Roxbury), .	•	1	'	ı	ı	33,670	'	1.23	1	ı
Boston (West Roxbury),	40.22	Separate,	2,067	6.75	14,830 4	28,600	1.96	8.92	51.9	22.0
Quincy,	48.95	Separate,	2,312	5.4	12,485	29,890	2.43	12.56	41.8	19.3
Totals,	479.51		26,019	7.2	188,150	825,090	26.76	100.87	67.9	26.5
	_	_		_						

1 Estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1906 extended to May 1, 1907.

<sup>4</sup> Including connection with Institution at Austin Farm having an estimated population of 880. 2 Estimated by City Engineer.

<sup>&</sup>lt;sup>3</sup> Part of town not included in Metropolitan Sewerage District.

WHOLE METROPOLITAN SYSTEM.

nected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Table showing Areas delivering Sewage to the Entire System, inclusive of Added High-level Area; Approximate Miles of Sewer con-Populations.

[Populations estimated as of December 31, 1907.]

System.	Miles of Local Sewer connected.	Separate or Combined.	Number of Con- nections with Local Sewers.	Estimated Number of Persons served by Each House Connection.	Estimated Population now con- tributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area Coutinately to P. Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
North Metropolitan,	624.74	624.74 Separate and combined,	65,786	6.4	422,065	498,640	Square Miles. 28.34	Square Miles. Square Miles. 28.34 90.50	Per Cent. 84.6	Per Cent. 30.1
South Metropolitan, .	479.51	Separate and combined,	26,019	7.2	188,150	325,090	98.78	100.87	67.9	26.5
Totals,	1,104.25	t	91,805	9.9	610,215	823,730	55.10	191.87	74.1	8.88

#### CAPACITY AND RESULTS.

The following tables summarize the pumping records for the year for the Metropolitan Sewerage stations:—

#### NORTH METROPOLITAN SYSTEM.

#### Deer Island Pumping Station.

At this station are three submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 56,500,000 foot-pounds. Average quantity raised each day: 64,300,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 3 screenmen and 1 relief screen-

man.

Coal used: first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

Table of Approximate Quantities, Lifts and Duties at the Deer Island Pumping Station of the North Metropolitan System.

Mon	rhs.		Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ftlbs per 100 lbs. Coal).
196 January, .	7.		2,275,100,000	73,400,000	60,800,000	114,900,000	10.91	59,500,000
February,			1,909,100,000	68,200,000	57,000,000	83,100,000	10.77	59,700,000
March, .			2,163,100,000	69,800,000	57,300,000	86,500,000	10.96	55,200,000
April, .			2,328,400,000	77,600,000	59,500,000	117,700,000	11.41	61,200,000
Мау, .			1,896,500,000	61,200,000	54,600,000	88,200,000	10.67	57,800,000
June, .			1,641,600,000	54,700,000	42,600,000	86,500,000	10.55	53,200,000
July, .			1,482,000,000	47,800,000	42,600,000	57,400,000	10.22	51,400,000
August, .			1,377,800,000	44,400,000	39,600,000	48,800,000	10.02	52,700,000
September,			1,663,500,000	55,500,000	38,300,000	127,400,000	10.44	56,000,000
October, .			1,881,800,000	60,700,000	47,500,000	89,000,000	10.61	56,200,000
November,			2,279,100,000	76,000,000	51,600,000	146,100,000	11.19	55,900,000
December,			2,536,700,000	81,800,000	66,700,000	108,500,000	11.67	59,300,000
Total,			23,434,700,000	-		-		_
Average,			_	64,300,000	51,500,000	96,200,000	10.79	56,500,000

#### East Boston Pumping Station.

At this station are three submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: 45,000,000 gallons each, with 19-foot lift.

Average duty for the year: 54,800,000 foot-pounds. Average quantity raised each day: 62,300,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 3 screenmen, 1 relief screenman

and 3 helpers.

Coal used: first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping
Station of the North Metropolitan System.

Mon	THS.		Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ftlbs. per 100 lbs. Coal).
January, .	7.		2,213,100,000	71,400,000	58,800,000	-112,900,000	17:07	56,000,000
February,			1,853,100,000	66,200,000	55,000,000	81,100,000	16.94	58,800,000
March, .			2,101,100,000	67,800,000	55,300,000	84,500,000	16.98	62,400,000
April, .			2,268,400,000	75,600,000	57,500,000	115,700,000	17.23	63,300,000
Мау, .			1,834,500,000	59,200,000	52,600,000	86,200,000	16.66	52,200,000
June, .			1,581,600,000	52,700,000	40,600,000	84,500,000	16.43	52,100,000
July, .			1,420,000,000	45,800,000	40,600,000	55,400,000	16.14	54,700,000
August, .			1,315,800,000	42,400,000	37,600,000	46,800,000	16.10	51,800,000
September,			1,603,500,000	53,500,000	36,300,000	125,400,000	16.42	50,300,000
October, .			1,819,800,000	58,700,000	45,500,000	87,000,000	16.61	52,900,000
November,			2,219,109,000	74,000,000	49,600,000	144,100,000	17.03	50,500,000
December,			2,474,700,000	79,800,000	64,700,000	106,500,000	17.32	52,900,000
Total,			22,704,700,000	, -		-	-	_
Average,	•	•	-	62,300,000	49,500,000	94,200,000	16.74	54,800,000

#### CHARLESTOWN PUMPING STATION.

At this station are three submerged centrifugal pumps, two of them having impellers or wheels 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: two, 22,000,000 gallons each, with 11-foot lift; one, 60,000,000 gallons, with 8-foot lift.

Average duty for the year: 56,700,000 foot-pounds. Average quantity raised each day: 32,600,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 3 screenmen and 1 relief screen-

man.

Coal used: first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping
Station of the North Metropolitan System.

Mon	HS.			Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ftlbs. per 100 lbs. Coal).
January, .	7.			1,096,600,000	35,400,000	30,200,000	50,500,000	8.50	63,100,000
February,				944,900,000	83,700,000	28,800,000	43,000,000	8.34	58,400,000
March,				1,050,700,000	33,900,000	27,900,000	45,500,000	8.38	56,200,000
April, .				1,124,300,000	37,500,000	30,000,000	55,100,000	8.55	61,800,000
May, .				924,800,000	29,800,000	25,500,000	44,790,000	8.13	56,300,000
June, .				851,600,900	28,400,000	23,000,000	43,800,000	8.00	56,500,000
July,				888,400,000	28,700,000	28,600,000	86,000,000	8.02	55,300,000
August, .				910,300,000	29,400,000	24,200,000	36,200,000	8.64	51,600,000
September,				992,900,000	33,100,000	26,600,000	53,900,000	8.25	56,900,000
October, .			•	922,000,000	29,700,000	24,600,000	42,100,000	8.07	51,900,000
November,				1,075,109,000	85,800,000	27,900,000	70,500,000	8.47	57,800,000
December,				1,101,200,000	35,500,000	27,800,000	46,900,000	8.81	54,100,000
Total,				11,882,800,000	-	-	-	-	-
Average,	•	•	•	· -	32,600,000	26,700,000	47,300,000	8.31	56,700,000

#### Alewife Brook Pumping Station.

The plant at this station consists of the original installation of small commercial pumps and engines, *i.e.*, two 9-inch Andrews vertical centrifugal pumps, with direct-connected compound marine engines, together with the recent additions. The latter consists of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the two original pumps: 4,500,000 gallons each, with 13-foot lift.

Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.

Average duty for the year: 19,300,000 foot-pounds. Average quantity raised each day: 4,123,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 2 screenmen, and 1 relief screen-

Coal used: first-quality Cumberland, costing from \$4.32 to \$4.90 per ton.

Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping
Station of the North Metropolitan System.

Mont	HS.		Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ftlbs. per 100 lbs. Coal).
January, .	7.		142,672,000	4,602,000	3,862,000	6,518,009	12.66	20,800,000
February,	•	•	112,797,000	4,029,000	3,574,000	5,170,000	12.92	18,100,000
March.			136,980,900	4,419,000	3,028,000	6,076,000	12.79	20,000,000
April, .			155,482,000	5,183,000	3,910,000	7,639,000	12.77	23,500,000
Мау, .			119,701,000	3,861,000	3,279,000	6,206,000	12.77	20,000,000
June, .			105,489,000	8,516,000	3,028,000	5,105,000	12.97	17,700,000
July,			93,033,000	8,001,000	2,598,000	3,766,000	13.10	15,300,000
August, .			76,284,000	2,460,000	2,120,000	3,079,000	13.13	13,600,000
September,			95,640,000	3,188,000	2,204,000	7,344,000	13.02	15,500,000
October, .			120,301,000	3,881,000	3,279,000	4,677,000	12.92	18,700,000
November,			161,561,000	5,385,000	3,279,000	9,114,000	12.87	23,600,000
December,			184,493,000	5,951,000	4,799,000	7,521,000	12.83	24,200,000
Total,			1,504,433,000	-	-	_	-	-
Average,			-	4,123,000	3,247,000	6,018,000	12.90	19,300,000

#### SOUTH METROPOLITAN SYSTEM.

#### Ward Street Pumping Station.

At this station are two vertical, triple-expansion pumping engines, of the Allis-Chalmers type, operating reciprocating pumps, the plungers of which are 48 inches in diameter with a 60-inch stroke.

Contract capacity of pumps: 50,000,000 gallons each, with 45-foot lift.

Average duty for the year: 82,200,000 foot-pounds. Average quantity raised each day: 23,500,000 gallons.

Force employed: 4 engineers, 4 firemen, 3 oilers, 4 assistant engineers, 1 machinist and 1 laborer.

Coal used: first quality Cumberland, costing from \$4.17 to \$5.00 per ton.

Table of Approximate Quantities, Lifts and Duties at the Ward Street Pumping Station of the South Metropolitan System.

Mont	нз.		Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ftlbs per 100 lbs. Coal).	
January, .	7.		796,700,000	25,700,000	23,000,000	37,800,000	41.52	88,500,000	
February,			575,000,000	20,500,000	18,000,000	26,600,000	41.25	74,200,000	
March, .			815,000,000	26,300,000	17,500,000	83,400,000	42.33	85,300,000	
April, .			867,000,000	28,900,000	19,400,000	37,200,000	42.21	87,000,000	
мау, .			719,000,000	23,200,000	20,000,000	81,200,000	41.50	76,500,000	
June, .			600,300,000	20,000,000	17,200,000	28,100,000	41.40	75,500,000	
July,	. •		550,200,000	17,700,000	14,000,000	23,300,000	41.10	70,500,000	
August, .			469,600,000	15,100,000	18,100,000	28,500,000	40.53	72,100,000	
September,			595,500,000	19,800,000	13,800,000	45,800,000	41.50	86,500,000	
October, .			682,200,000	22,000,000	17,000,000	38,800,000	42.03	87,000,000	
November,			912,000,000	30,400,000	21,300,000	66,100,000	41.82	91,400,000	
December,			1,007,500,000	32,500,000	25,900,000	46,100,000	41.70	92,000,000	
Total,			8,590,000,000	-	-	-	-	-	
Average,			_	28,500,000	18,000,000	36,900,000	41.57	82,200,000	

Records from plunger displacement. Average slip for the year about 9.9 per cent.

#### Quincy Pumping Station.

At this station are two compound condensing Deane pumping engines and one Lawrence centrifugal pump driven by a Sturtevant compound condensing engine.

Contract capacity of pumps: 3,000,000 Deane; 5,000,000 Deane; 10,000,000 Lawrence centrifugal.

Average duty for the year: 31,800,000 foot-pounds. Average quantity raised each day: 3,616,000 gallons.

Force employed: 3 engineers, 1 relief engineer, 2 screenmen and 1 relief screenman.

Coal used: first-quality Cumberland, costing from \$4.75 to \$5.25 per ton.

Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.

Mon			Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ftlbs per 100 lbs. Coal).	
190	7.								
January, .			•	123,764,000	3,992,000	3,583,000	4,505,000	20.88	36,000,000
February,		•	•	101,133,000	3,611,000	3,253,000	3,920,000	21.50	33,000,000
March, .	•	•	•	131,635,000	4,246,000	3,360,000	5,650,000	21.43	33,500,000
April, .	•	•	•	128,690,000	4,289,000	3,770,000	4,980,000	21.04	33,000,000
May,	•	•	•	114,159,000	3,683,000	3,340,000	3,940,000	20.99	33,800,000
June, .	•	•	•	105,640,000	3,521,000	3,100,000	4,520,000	20.98 20.99	31,200,000
July, .	•	•	•	92,257,000	2,974,000	2,710,000 2,360,000	3,340,000	20.99	28,800,000 30,800,000
August, . September,	•	•	•	80,346,000 80,662,000	2,592,000 2,688,000	2,319,000	2,960,000 3,520,000	20.94	31,300,000
October.	:	•	:	96,414,000	3,110,000	2,800,000	3,380,000	20.88	32,600,000
November.	:	•	•	114,887,000	3,830,000	2,950,000	5,720,000	20.87	29,200,000
December,			•	150,257,000	4,847,000	3,940,000	5,836,000	21.03	28,600,000
Total,				1,319,844,000		-	-	-	-
Average,				_	3,615,000	3,124,000	4,356,000	21.04	31,800,000

#### Nut Island Screen House.

The plant at the house includes two sets of screens in duplicate, actuated by small reversing engines of the Fitchburg type. Two vertical Deane boilers, 80 horse-power each, operate the engines, provide heat for the house and burn materials intercepted at the screens.

Average quantity of sewage passing screens daily, 40,600,000 gallons. Total materials intercepted at screens during the past year, 1,056 cubic yards. Materials intercepted per million gallons of sewage discharge, 1.92 cubic feet. Force employed: 3 engineers, 1 relief engineer, 3 screenmen and 1 relief screenmen

Coal used: 294 tons first-quality Cumberland, costing from \$3.95 to \$4.98 per ton.

#### COST OF PUMPING.

In the following tables the total cost of pumping and the rate per million foot-gallons at each of six pumping stations are shown in detail:—

Average Cost per Million Foot-gallons for Pumping at the Deer Island Station.

Volume (23,434.7 Million Gallons) × Lift (10.79 Feet) = 252,860 Million Foot-gallons.

				Cost.	Cost per Million Foot-gallons.								
Labor,												\$11,147 08	\$0.04409
Coal,												9,242 52	.03655
Oil, .												248 01	.00098
Waste,												89 69	.00036
Water,												1,067 40	.00422
Packing	,										. ]	219 92	.00087
Miscella	neo	us su	ıppli	ев аг	nd re	newa	ıls,					2,458 50	.00972
Tota	ls,							٠.	•			\$24,473 07	\$0.09679
Labor a	t sc	reen	3, .								.	-	.01079

## Average Cost per Million Foot-gallons for Pumping at the East Boston Station. Volume (22,704.7 Million Gallons) × Lift (16.74 Feet) = 380,076 Million Foot-gallons.

					Cost.	Cost per Million Foot-gallons.							
Labor,											.	\$14,187 31	<b>\$</b> 0.03733
Coal,												12,432 35	.03271
Oil, .												390 29	.00103
Waste,												86 23	.00023
Water,									•			1,396 80	.00367
Packing	<b>5</b> ,						•					44 87	.00012
Miscella	neo	us sr	ıppli	es ar	ıd re	newa	ls,					2,146 61	.00565
Tota	ıls,											\$30,683 96	\$0.08074
Labor a	t sc	reens	3, .									-	.00718

### Average Cost per Million Foot-gallons for Pumping at the Charlestown Station. Volume (11,882.8 Million Gallons) × Lift (8.31 Feet) = 98,746 Million Foot-gallons.

	ITEMS.														Cost per Million Foot-gallons.
Labor,													.	\$11,176 51	\$0.11319
Coal,													٠.	<sup>*</sup> 8,730 66	.03778
Oil,													.	202 00	.00204
Waste,													.	106 12	.00107
Water,		٠.											.	411 60	.00417
Packing	ζ,												.	<b>54</b> 01	-00055
Miscella	inec	us su	ippli	es aı	ad re	new	als,							956 93	.00969
Tota	als,													\$16,637 83	\$0.16849
Labor a	t sc	reen	3, .											-	.02896

### Average Cost per Million Foot-gallons for Pumping at the Alewife Brook Station. Volume (1,504.4 Million Gallons) $\times$ Lift (12.80 Feet) = 19,406 Million Foot-gallons.

	ITEMS.														Cost per Million Foot-gallons.		
Labor,													.	\$4,378 65	\$0.22563		
Coal,													.	1,782 41	.09185		
Oil,													.	107 07	.00552		
Waste,								:					.	45 43	.00234		
Water,													.	170 16	.00877		
Packing													.	15 48	.00079		
Miscella	neo	us st	ppli	es ar	ıd re	newa	ıls,			•			.	177 05	.00912		
Tota	ls,												.	\$6,676 20	\$0.34402		
Labor a	t sci	eens	, .										.	-	.09879		

## Average Cost per Million Foot-gallons for Pumping at the Ward Street Station. Volume (8,590 Million Gallons) $\times$ Lift (41.57 Feet) = 857,090 Million Foot-gallons.

	ITEMS.														Cost per Million Foot-gallons.
Labor,													.	\$14,024 93	\$0.03928
Coal,				•									.	8,451 03	.02367
O11,													.	206 32	.00058
Waste,	•				•								.	67 83	.00019
Water,													.	1,312 80	.00368
Packing	ζ,												.	830 71	.00232
Miscella	aneo	us st	ıppli	es aı	nd re	news	als,			٠.			.	1,446 28	.00405
Tota	als,												.	\$26,339 90	\$0.07377
Labor a	t scı	eens	١, .										.	-	.01070

Average Cost per Million Foot-gallons for Pumping at the Quincy Station.

Volume (1,319.8 Million Gallons) × Lift (21.04 Feet) = 27,768 Million Foot-gallons.

						ITBM	8.				Cost.	Cost per Million Foot-gallons.
Labor,											\$4,833 58	\$0.17407
Coal,		•		•							1,701 25	.06126
Oil,											25 15	.00091
Waste,											14 16	.00051
Water,											191 52	.00690
Packing	ζ,	•								.	42 39	.00158
Miscella	anec	us s	uppli	es ai	ad re	newa	als,				243 26	.00876
Tota	als,									.	\$7,051 31	\$0.25394
Labor a	ıt sc	reen	8, .								_	.05618

Coal for use at the several stations has been purchased as follows:—

		6	Ross Tons	, Bitumino	OUR COAL.			
	Deer Island Pumping Station.	East Boston Pumping Station.	Charles- town Pumping Station.	Alewife Brook Pumping Station.	Ward Street Pumping Station.	Quincy Pumping Station.	Nut Island Screen House.	Price per Gross Ton.
Metropolitan Coal Com-	1,635	1,808.53	586	_	-	-	200	\$3.90
Metropolitan Coal Com-	-	-	-	-	1,555.15	-	-	4.17
pany. Locke Coal Company,.	-	-	-	298.127	_	-	-	4.89
George E. Frost & Co.,	- '	-	-	-	-	287.84	-	4.70
Locke Coal Company, .	-	-	-	136.490	-	-	-	4.90
Metropolitan Coal Com-	481	910.00	215	-	_	-	-	4.9
pany. Metropolitan Coal Com-	-	-	-	-	457.48	-	-	5.0
pany. George E. Frost & Co.,	-	-		-	-	90-83	-	5.2
Total gross tons, .	2,116	2,718.53	801	434.617	2,012.63	878.17	200	-
Average price per gross ton.	\$4.18	\$4.29	\$4.23	\$4.50	\$4.35	\$4.87	\$3.95	-

### SOUTH METROPOLITAN OUTFALLS.

The 60-inch outlet pipes in the harbor have been in operation three years at the date of this report. Studies of the hydraulic condition of these pipes indicate they are in normal condition and free from deposit. During the past year the average flow through them

## 178 MET. WATER AND SEWERAGE BOARD. [P. D. 57.

has been 40,600,000 gallons of sewage per day, with a maximum rate of 137,000,000 gallons at a time of heavy rain about December 1, 1907.

#### MATERIAL INTERCEPTED AT THE SCREENS.

The material intercepted at the screens at the North Metropolitan sewerage stations, consisting of rags, paper and other floating matters, has during the year amounted to 2,422.2 cubic yards. This is equivalent to 2.8 cubic feet for each million gallons of sewage pumped at Deer Island.

The material intercepted at the screens at the South Metropolitan sewerage stations has amounted to 2,735.6 cubic yards, equal to 5.0 cubic feet per million gallons of sewage delivered at the outfall works at Nut Island.

Studies of sewage flows in the Metropolitan sewers, siphons and outfall pipes indicate that they are satisfactorily free from deposit and in normal condition.

## Respectfully submitted,

WM. M. BROWN,
Chief Engineer of Sewerage Works.

Boston, January 1, 1908.

# APPENDIX.

## APPENDIX No. 1.

#### CONTRACTS MADE AND PENDING DURING

[NOTE. - The details of contracts made before

	1.	2.	3.	AMOUNT	or Bid.	6.
	Num- ber of Con- tract.	WORK.	Num- ber of Bids.	4. Next to Low- est.	5. Lowest.	Contractor.
1	288	Pumping engine for the Arlington station.	7	\$7,900 00	<b>\$7,830</b> 00	Allis - Chalmers Co., Milwaukee, Wis.
2	294 1	Arlington pumping station.	5	29,098 00	28,328 00 2	C. A. Dodge & Co., Boston.
8	295 1	Sterling filter beds, Sterling, Mass.	.5	10,230 50	9,803 50 2	A. McKenzie & Co., Leominster, Mass.
4	297 1	Horizontal return tubular boilers, Arlington and Chestnut Hill stations.	8	6,694 00 2	6,600 00	Hodge Boiler Works, Boston.
5	298	Pumping engine for the Arlington station.	2	12,700 00	5,240 00 2	Blake & Knowles Steam Pump Works, Boston.
6	9.M 1	Repairing boiler at Chest- nut Hill high-service pumping station.	2	2,766 00	1,791 00 2	Hodge Boiler Works, Boston.
7	10-M	Placing riprap at North Dike, Clinton, Mass.	2	19,250 00	14,000 00 2	Hugh Nawn Contract- ing Co., Boston.
8	Special Order.1	Furnishing and erecting electric apparatus in gate-house at Wachu- sett Dam.	8.	888 23	864 00 2	Frank Ridlon Company, Boston.
9	Special Order.1	Hercules water wheel at Wachusett Dam.	2	1,050 00	900 00 2	Holyoke Machine Co., Holyoke, Mass.
10	Special Order. <sup>1</sup>	Cut stone for retaining wall at the Arlington pumping station.	4	687 90	598 00 2	John Harrington, East Cambridge, Mass.

<sup>&</sup>lt;sup>1</sup> Contract completed.

<sup>&</sup>lt;sup>2</sup> Contract based upon this bid.

## APPENDIX No. 1.

THE YEAR 1907 — WATER WORKS.

1907 have been given in previous reports.]

7.	8.	9.		10.	
Date of Contract.	Date of Completion of Work.	Prices of Principal Contracts made in		Value of Work done Decem- ber 31, 1907.	
Oct. 28, '05,	_	-	-	\$9,900 00	1
Aug. 23, '06,	July 19, '07,	-	-	29,498 21	2
Sept. 1, '06,	May 25, '07,	-	-	11,893 75	3
Jan. 30, '07,	Oct. 7, '07,	For whole work, \$6,694, .		6,694 00	4
Apr. 3, '07,	-	For whole work, \$5,240,		4,000 00	5
Nov. 28, '06,	Apr. 11, '07,	-	-	1,791 00	6
Sept. 6, '07,	-	Riprap in place, \$2.00 per cub	lc yard,	12,800 00	7
June 7, '06,	Apr. 8, '07,	-	-	864 00	8
Aug. 27, '06,	June 15, '07,	-	-	900 00	9
Nov. 16, '06,	Mar. 30, '07,	<b>-</b> ·	-	598 00	10
		•		<b>\$</b> 79,438 96	

## CONTRACTS MADE AND PENDING DURING THE YEAR 1907 — WATER WORKS — Concluded.

#### Summary of Contracts.

										Value of Work done Decem- ber 31, 1907.
Wachusett Reservoir, 1 contract, .										\$11,893 75
Distribution Department, 4 contracts,										50,092 21
Total of 5 contracts made and pen	ding	dur	ing t	he ye	ar 19	907,				\$61,985 96
288 contracts completed from 1896 to 19	906, 1	inclu	sive,							15,715,263 93
										\$15,777,249 89
Deduct for work done on 11 Sudbury	Rese	ervoi	r con	trac	a by	the e	city o	f Bo	ston,	512,000 00
Total of 304 contracts,										<b>\$15,265,249</b> 89

<sup>1</sup> In this summary, contracts charged to maintenance are excluded.

APPENDIX NO. 2.

	Totale.	£8.83	18.37	8.78	£7.48	18.41	62.10	88.24	19.18	11.07	51.88	43.84	46.13	15.74	44.88
														_	
	.төсөшрөт.	4.02	4.83	10.7	4.78	4.30	4.17	4.58	4.82	3.66	6.25	88.88	4.48	4.40	4.47
in 1907	Долешрет.	5.52	8.03	5.48	5.99	5.58	5.84	9.09	7.05	5.63	7.91	6.76	6.16	5.74	6.12
Works,	Осторет.	5.48	6.51	5.62	6.10	4.27	3.83	4.07	4.51	3.96	3.65	3.98	4.04	5.68	4.17
. Water	.тэфтэтдэВ	9.45	9.70	8.74	10.10	8.97	8.82	8.07	89.68	7.62	10.02	88.88	90.6	9.50	8.78
ropolitan	August.	1.00	1.87	1.05	1.61	1.09	1.07	1.05	1.07	1.27	1.79	1.33	1.25	1.26	1.07
the Met	July.	3.031	3.09	8.53	2.48	1.56	1.71	2.03	2.12	1.45	1.49	1.91	2.22	3.03	1.86
laces on	June.	3.54 1	3.49	3.49	3.64	3.46	3.20	2.91	4.56	.88 88	8.39	8.71	8.48	3.54	8.58
Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, in 1907	May.	18.5	3.14	2.78	3.11	3.60	3.53	3.53	3.87	3.62	4.06	3.08	8.87	3.98	8.8
hes at V	April.	2.07	3.04	2.23	8.26	8.51	3.05	3.30	3.67	3.47	8.72	3.31	3.16	2.65	3.41
ill in Inc	March.	1.61	1.87	1.85	2.06	1.81	1.79	1.86	2.19	1.88	2.44	2.43	1.97	1.82	1.91
y Rainfo	February.	1.86	2.37	2.79	2.27	2.17	2.18	2.13	2.21	2.18	3.31	2.19	2.83	2.32	2.17
-Monthl	January.	2.64	2.96	2.71	3.06	8.14	3.41	3.16	3.43	3.14	8.80	2.90	3.12	2.84	3.28
1: -		•	•	•	•	•	•	•	•	•	•	•	•	hed,	d, .
No.		•	•	•	•	•	•	•	•	•	•	•	•	watershed,	watershed,
		•	•	•	•	•	•	•	•	•	olr, .	•	•	ett w	y wat
TABLE	PLACE.	•	•	•	•	am,	'n.	am,	•	•	Berv	•	T	chus	1bur)
`	Ĕ.	Princeton,	Jefferson,	Sterling, .	Boylston, .	Sudbury Dam,	Framingham,	Ashland Dam,	Cordaville,	Lake Cochituate,	Chestnut Hill Reservoir, .	Spot Pond, .	Average of all,	Average, Wachusett	Average, Sudbury
		d.		ach ater	M	d.	sys.	lbu iste	M	Lake	Chest	Spot ]	A	₹	¥

1 No record. Average of other three places on the waterehed.

TABLE No. 2. — Rainfall in Inches at Jefferson, Mass., in 1907.

	:	Dat	r o <b>y</b>	Mo	NTH.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,					•		-	0.251	-	3	-	-	-	-	-	-	-	_
2,					•		-	-	0.48	0.331	-		-	0.33		-	3	-
8,	•		•	•	•	•	2	-	-	-	-	0.75	-	-	3	-	1.85	-
4,	•		•	•	•		0.42	2	0.041	-	0.89	2	-	0.40	1.51	0.65	-	0.081
5,	•		•	•	•		-	1.521	-	-	. <b>-</b>	0.42	-	-	0.66	-	-	-
6,	•		•	٠	•		-	-	-	-	0.14	-	0.38	-	-	-	2	-
7,	•		•	•	•	•	2	-	-	-	-	-	-	-	-	0.11	2.14	-
8,	•		•	•	•	•	0.85	-	0.081	1.041	-	-	-	-	0.09	3.07	-	-
9,	٠	•	•	•	•	•	-	-	-	3	0.11	2	-	-	-	-	-	-
10,	•		٠	•	•	•	-	0.041	0.081	0.821	-	0.24	-	-	1	-	0.44	1.32
11,	•	,	•	•	•	•	-	-	-	-	0.36	-	2	-	1.02	0.06	-	-
12,	•	•	٠	٠	•	•	0.288	-		-	-	-	1.17	-	-	-	-	-
13,	•	•	•	•	•	•	-	-	0.19	-	-	-	-	-	-	-	-	-
14,	•	•	•	•	•	٠	0.221	-	0.38	-	-	-	-	-	-	-	-	2
15,	•	•	•	٠	٠	•	-	-	-	-	-	-	-	-	-	-	-	1.61
16,	٠	•	•	٠	•	•	-	-	0.081	-	0.82	-	-	-	-	-	-	-
17,		•	•	•	•	•	3	-	-	-	-	-	0.54	0.25	-	-	-	-
18,	•	•	•	•	•	•	2	-	-	-	-	-	-	-	-	-	2	-
19,	•	•	•	•	•	•	0.408		0.25	-	-	-	-	-	-	-	0.27	-
20,		•	•	•	•	•	-	0.111	-	-	0.19	-	0.48	-	-	0.52	-	-
21,		•	•	•	•	•	-	-	-	-	-	-	-	0.05	0.60	-	-	-
22,		•	•	•	•	•	0.331	-	-	-	-	0.31	-	-	2	-	-	-
23,		•	•	•	•	•	-	-	-	3	-	-		-	8.70	-	-	1.20
24,		•	•	•	•	•	-	*	0.441	0.70	-	-	0.10	0.11	-	-	2	-
<b>2</b> 5,		•	•	•	•	•	3	0.381	-	-	-	-	-	-	-	-	1.128	l
<b>2</b> 6,		•	•	•	•	•	0.901	-	-	-	8	0.17	0.42	-	-	-	0.208	-
<b>2</b> 7,		•	•	•	•	•	-	-	-	-	1.06	-	-	0.09	-	1	-	-
28,		•	•	•	•	•	-	-	-	0.15	-	-	-	-			-	0.02
<b>2</b> 9,		•	•	•	•	•	-	-	-	-		8	-	-	2.12	2.10	-	-
30,		•	•	•	•	•	-	-	-	-	0.07	1.60	-	0.14	-	-	-	0.59
81,		• •		•	•	•	0.051	-		-		-	-	-			-	-
	1	Fote	al,	•	•	•	2.95	2.37	1.87	3.04	8.14	3.49	3.09	1.37	9.70	6.51	6.02	4.82

<sup>1</sup> Snow.

Total for the year, 48.37 inches.

Rainfall included in that of following day.

<sup>8</sup> Rain and snow.

Table No. 3. — Rainfall in Inches at Framingham, Mass., in 1907.

		Dat	OF	Mox	TH.		January.	February.	March.	April.	Мау.	June.	July.	August.	September.	October.	November.	December.
1,							-	0.25	2		-	-	-	-	-	-	-	0.151
2,							-	0.05	0.40	0.258	-	2	0.02	0.03	3	-	2	-
8,							2	-	2	-	-	1.49	-	-	3	2	1.28	2
4,					•		0.59	,	0.111	2	0.85	-	-	0.81	2	0.45	-	0.171
5,					•	•	-	1.031	-	0.04	-	0.22	-	2	1.98	0.02	-	-
6,				• .	•		-	-	-	-	2	-	0.14	0.02	-	-	2	-
7,	•			٠	•		•	-	-	-	0.29	-	-	-	-	-	1.72	-
8,	•		•	•	•	•	0.42	-	0.061	2	2	-	-	-	0.14	1.87	-	-
9,	•			•	•	•	-	-	<del>-</del> -	2	0.11	2	-	-	-	-		-
10,	•		•	•	•	•	-	0.058	0.141	8	2	0.26	-	-	-	-	0.45	1.25
11,	•		•	•	•	•	-	-	-	1.79*	0.908	-	•	-	0.47	0.02	-	-
12,	•		•	•	•	•	0.248	-	3	-	-	-	0.60	-	-	-	-	-
13,	•		•	•	•	•	-	-	2	0.278	-	-	-	-	-	-	-	-
14,	•		•	•	•	•	2	-	0.27	-	-	-	-	-	-	-	-	1
15,	•		•	•	•	•	0.29	-	0.011	-	-	-	-	-	-	-	-	1
16,	•		•	•	•	٠	-	-	-	- !	2	-	-	-	-	-	-	1.848
17,	•		•	•	•	٠	0.111	0.061	-	-	0.53	-	0.10	0.15	-	-	-	-
18,	•		•	•	•	٠	-	-	-	-	-	0.03	-	-	-	-	2	-
19,	٠		•	٠	•	٠	0.36	0.118	0.808	0.063		<b>-</b> .	-	-	-	-	0.84	-
20,	•		•	•	•	•	-	0.311	-	-	0.87	0.08	0.12	-	-	0.46	-	-
21,	•		•	•	•	٠	-	-	-	-	-	0.05	-	0.02	0.84	-	0.08	-
22,	•		•	•	•	٠	0.231	-	-	-	-	-	-	-	2	-	-	-
23,	•		•	•	٠	•	-	-	-	2	-	-	-	-	2.62	-	-	0.70
24,	•		•	•	•	٠	-	0.801	0.268	0.57	-	-	1	*	0.11	-	2	-
25,	•		•	· •	•	•	3	-	-	-	-	-	0.40	0.14	-	-	1.93	-
26,	•		•	•	•	•	0.931	-	<b>-</b>	0.02	3	0.08	0.31	-	-	-	0.048	-
27,	•		•	•	•	٠	-	-	0.10	-	0.96	-	-	0.11	-	8	-	-
28,	•		•	•	•	•	-	0.021	0.08	2	-	-	-	-	2	2	-	0.01
29,	•		•	•	•	٠	*	-	-	0.03	-	8	0.02	-	2.71	*	-	_
80,	•		•	•	•	•	0.051	- ,	-	0.02	0.02	1.06	-	0.29	-	1.51	-	0.55
81,	•		•	•	٠	٠	0.191	-	0.068	-								
	Т	ota	ι,	•	•	·	3.41	2.18	1.79	8.05	8.53	8.20	1.71	1.07	8.32	8.83	5.84	4.17

Total for the year, 42.10 inches.

<sup>1</sup> Snow. 2 Rainfall included in that of the following day.

a Rain and snow.

Table No. 4. — Rainfall in Inches at Chestnut Hill Reservoir in 1907.

DATE.	Amount.	Duration.	DATE	Amount.	Duration.
an. 3, .		4.00 P.M. to	May 4,	-54	6.25 A.M. to 1.30 P.I
an. 4, .	• 13	8.00 P.M.	May 6,	.32	6.20 A.M. to 11.30 P.J
an. 7, •	.441	9.07 P.M. to	May 9	.14	5.00 A.M. to 1.30 P.I
an. 9, . an. 12, .	. 33 1	9.30 A.M. to 9.00 P.M.	May 10	1.22 2	11.00 P.M. to
an. 14,	. 42 2	7.45 A.M. to 6.80 P.M.	May 11,	11	1.30 P.I
an. 17,	171	11.30 A.M. to 6.00 P.M.	MININ TOE	.70	8.15 P.M. to 5.10 A.1
an. 19.	80	9.30 A.M. to 10.40 P.M.	May 17,	13	5.25 P.M. to
an. 22.	. 26 1	8.30 A.M. to 8.15 P.M.	May 20,	{ .43	7.30 A.1
an. 25,	1.141	7.05 A.M. to	May 26	.67	11.30 A.M. to
an. 26,	.   )	1.15 P.M.	May 27	13 .01	11.55 P-3
an. 29, . an. 30, .	14 1	11.45 P.M. to 10.80 A.M.	May 30,	.02	7.00 P.M. to
•	, ,	10.50 A.A.	May 30, May 31, May 31,	.02	2.50 A.1 9.00 P.M. to 9.30 P.1
Total,	. 3.80		Total,	4.06	
eb. 1, .	31 1			1	
eb. 2, .	. 24	1.80 A.M. to 7.45 A.M.		i -	
eb. 2,	.02	11.20 P.M. to	June 2,	1.67	8.15 A.M. to
eb. 8, . eb. 4, .	: 13.	12.40 A.M. 10.40 P.M. to	June 3,	11.01	4.30 P.
eb. 6,	1.33 1	2.00 P.M.	June 5,	.87	9.00 A.M. to
eb. 5, .		4.15 P.M. to	June 6,	13	1.40 A.
eb. 6	. 11	9.30 A.M.	June 9, June 10,	20	10.45 A.M. to 7.10 A.
eb. 10.	. 13 1	5.25 A.M. to 12.30 P.M.	June 20,	' .02	6.00 A.M. to 6.30 A.
eb. 11,   .	03 1	5.30 P.M. to 6.00 P.M.	June 26,	.04	7.00 P.M. to 10.45 P.
eb. 17.   •	.251	7.80 P.M. to 12.00 M.	June 29,	1 3	5.30 P.M. to
Bb. 18, •	. 081	3.30 P.M. to 9.00 P.M.	June 30,	1.09	9.20 A.
eb. 19, . eb. 20, .	1.	4.45 P.M. to			
eb. 21, .	.491	3.25 A M.	Total, .	3.39	
eb. 24.	. 311	5.00 P.M. to		.!	
eb. 25.	.   )	8.45 A.M.	Y-1- 0	.03	100 4 34 40 4 98 4
eb. 28,	. 06	6.45 P.M. to 10.00 P.M.	July 8, · ·	.08	1.30 A.M. to 4.35 A. 12.15 P.M. to 1.00 P.
	0.01		July 8, · ·	1	10.30 A.M. to
Total,	. 3.31		July 9, July 11, July 12,	₹ .50	11.30 A.
	-i.	1 7 05	July 17,	.09	9.00 P.M. to 10.30 P.
ar. 2, . ar. 3, .	.62 2	1.25 A.M. to 6.20 A.M.	July 20	.19	9 30 P.M. to 11.50 P.
ar. 8, .	.131	8.80 A.M. to 2.30 P.M.	July 24,	.27	10.00 P.M. to
ar. 10,	1 2	9.30 A.M. to	July 25, July 26,	.33	3.15 A. 7.05 A.M. to 10.35 A.
ar. 11,	:   { -18 1	2.25 A.M.	July 20,	.00	7.00 A.M. 10 10:05 A.
ar. 18	27	1.00 A.M. to 10.80 A.M.	Total	1.49	
ar. 14,	. 10	4.15 A.M. to 1.30 P.M.	20,	1	
ar. 18,	. 04	1.45 A.M. to 2.20 A.M.		i	
ar. 19,	.36 2	2.00 P.M. to 12.15 A.M.	Aug. 4,	.40	3.30 A.M. to 12.15 P.
ar. 20, . ar. 24, .	24 1	1.00 A.M. to 10.30 P.M.	Aug. 5	1 .11	10.30 P.M. to
ar. 27.	1	11.50 P.M. to	Aug. 6,		1.30 P.
ar. 28	:   { -15	2.10 A.M.	Aug. 17,	.19	4.85 A.M. to 5.50 A.
ar. 28	. 09	12.50 P.M. to 1.15 P.M.	Aug. 17,	.11	10.80 A.M. to 12.80 P. 4.15 P.M. to 5.30 P.
ar. 31, .	. } .26	11.50 P.M. to	Aug. 21, Aug. 24,	.10	4.15 P.M. to 5.30 P. 9.15 A.M. to
pr. 1, .	.   1	7.00 A.M.	Aug. 24,	14	9.10 A.M. W
Total	. 2.44		Aug. 27,	.23	8.30 P.M. to
Total,	2.44	l·	Aug. 28	} .25	5.20 A.
nr 1	1,	7.00 A.M. to	Aug. 30,	.51	1.40 P.M. to
pr. 1, . pr. 2, .	. 20 º	2.50 A.M.	Aug. 81,	13 .01	4.25 A.
pr. 2, . pr. 5,	:   ' .10	6.00 A.M. to 10.30 A.M.	moto1	1.79	
pr. 8	. 1.20 2	8.30 A.M. to 12.00 M't.	Total, .	1.19	
pr. 9, .	1.122	7.00 A.M. to		<del> </del>	
pr. 10, •	.   5 12 -	4.05 A.M.	G4 2	1.	0 00 4 Nr 40
pr. 10,  .	.06	11.30 A.M. to	Sept. 2,	8.34	8.00 A.M. to 3.15 P.
pr. 11, .	.25	5.15 A.M. 6.10 A.M. to 3.30 P.M.	Sept. 5, Sept. 8,	.06	10.45 A.M. to 4.30 P.
pr. 13, .	1.	6.10 A.M. to 3.30 P.M. 10.50 P.M. to	Sept. 11,	.31	8.40 P.M. to 11.40 P.
pr. 16,  . pr. 17,  .	:   { .04 2	3.05 A.M.	Sept. 21,	.23	7.15 P.M. to 10.00 P.
pr. 19,	. 05	1.05 P.M. to 6.15 P.M.	Sept. 22,	2.35	10.00 P.M. to
pr. 23,	1	9.40 P.M. to	Sept. 24,	2.50	12.20 A.
pr. 24, .	.   { .60	10.15 A.M.	Sept. 24,	1 .10	6.40 P.M. to
pr. 28.	.05	11.10 A.M. to	Sept. 25,	}	1.30 A.
pr. 29,	.   )	7.30 A.M.	Sept. 28.	3.63	10.30 A M. to 6.30 P.
(ay 1, .	.05	2.10 A.M. to 3.55 A.M.	Sept. 29,	'	0.00 1
Total,	. 3.72		Total, .	10.02	•

<sup>1</sup> Snow.

<sup>&</sup>lt;sup>2</sup> Rain and snow.

TABLE No. 4. — Rainfall in Inches at Chestnut Hill Reservoir in 1907 — Concluded.

DATE.	Amount.	Duration.	DATE.	Amount	Duration.
Oct. 4,	.49 .05 1.67 .47 .76 .21	4.49 A.M. to 11.00 P.M. to 1.15 A.M. 3.25 A.M. to 2.30 P.M. 5.10 A.M. to 5.55 A.M. to 6.20 A.M. 3.15 P.M. to 7.00 P.M.	Dec. 1,	\ \begin{array}{c} \ \ .061 \\ .351 \\ 1.71 \\ \ \ \ 2.325 \\ .98 \\ \ \ .83 \end{array}	8.80 A.M. to 1.20 A.M 3.25 A.M. to 5.30 P.M 10.30 A.M. to 10.30 P.M 11.45 A.M. to 9.00 P.M 7.15 A.M. to 9.00 P.M 7.15 A.M. to 1.25 A.M
Nov. 2,	7.00	4.45 P.M. to 6.30 A.M. to 7.30 A.M. to 3.55 A.M. to 7.80 P.M. to 8.15 A.M. to 4.30 P.M. to 3.15 P.M. to 1.45 P.M. 5.05 A.M. 7.00 P.M. 12.10 A.M.			

Total for the year, 51.83 inches.

<sup>1</sup> Snow.

<sup>&</sup>lt;sup>2</sup> Rain and snow.

Table No. 5.—Rainfall in Inches on the Wachusett Watershed, 1897 to 1907.

	YBAL	نہ	!	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1897,		•		8.46	2.86	10.4	28.2	5.06	5.11	8.66	8.47	1.88	76.0	7.62	6.41	51.84
1908,		•	•	9.60	8.30	2.27	4.48	88.88	3.11	8.01	19.01	3.15	7.21	6.81	3.99	57.92
1899,		•	•	3.88	5.12	6.75	1.94	1.83	5.51	.8.82	8.20	4.11	2.72	1.94	2.03	41.40
1900,		•	•	4.56	8.69	6.19	2.78	4.84	3.59	3.20	3.18	3.46	2.90	6.44	3.15	52.46
1001		•	•	1.75	1.18	5.83	9.64	7.03	1.51	2.68	4.58	3.10	3.70	2.43	9.36	55.70
1902,		•	•	2.72	4.91	12.9	4.38	2.24	19.2	8.87	3.95	4.36	6.36	0.83	1.20	48.58
1908,	•	•	•	2.86	4.43	6.58	3.10	1.24	10.37	8.43	3.88	2.93	4.48	2.38	3.99	49.58
1904,		•	•	4.02	2.66	3.40	7.45	2.99	8.44	3.84	3.68	2.30	1.78	1.62	2.88	43.06
1906,		•	•	6.10	1.72	3.95	3.60	0.83	4.88	5.39	8.09	9.90	1.81	2.52	3.79	48.58
1906,		•	•	3.50	2.74	5.17	8.12	89.9	5.95	5.52	4.34	2.61	3.95	2.25	4.26	49.08
1907,		•	•	28.	2.82	1.82	3.65	3.86	3.54	3.03	1.26	9.50	5.68	5.74	4.40	46.74
Total,	•	•	•	40.47	89.87	51.28	14.87	87.97	49.52	49.43	45.24	47.25	41.48	40.66	51.46	538.94
A v 61	Average (11 years)	11 yea	re),	8.68	8.62	4.68	4.08	8.45	4.50	4.49	4.11	4.30	8.77	8.70	4.68	48.99

Norg. — The figures tabulated are means of observations at four places, as follows: January, 1887, to December, 1900, Princeton, Jefferson, Sterling and South Clinton; January, 1901, to December, 1907, Princeton, Jefferson, Sterling and Boylston.

Table No. 6.—Rainfall in Inches on the Sudbury Watershed, 1875 to 1907.

	Totals.	444218488484444258844888484844444 4888844484488884486648888444444	1,517.71	45.39
	December.	○ \$\$ ○ \$\$ ○ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$	127.43	3.86
	November.	4 7 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8	129.58	3.88
	October.	40000000000000044400000000000000000000	136.87	4.12
	September.	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	118.62	3.59
	August.	61.88.60.41.10.4.10.4.88.4.4.8.8.8.4.4.8.8.8.4.4.8.8.8.8.8	128.45	3.89
	July.	8853828282839108810881088109810981098109810981098109	120.86	3.66
	June.	644888646114884148888888888888888888888	105.02	8.18
	May.	88889998989999999999999999999999999999	110.92	8.86
	April.	\$\frac{4}{4}\$\text{\$\}\$}}}}\$\text{\$\text{\$\text{\$\text{\$\text{\$\text{\$\text{\$\ti	117.26	3.55
	March.	######################################	149.17	4.52
	February.	84000844888888888888888888888888888888	137.43	4.17
	January.	41.6246.626.626.626.626.626.626.626.626.62	137.20	4.16
	YEAR.	1877, 1877,	Total,	Average (33 years),
Į.				

1 Means of observations at several places, as follows: January, 1875, to April, 1876, Lake Cochituate; April to June, 1876, Lake Cochituate, Westborough and Hopkinton; June to December, 1876, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to January, 1883, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to January, 1884, Framingham and Southborough; January, 1884, to January, 1890, Framingham, Ashland Dam; June, 1898, to December, 1907, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

TABLE No. 7.—Yield of the Wachusett Watershed in Gallons per Day per Square Mile' from 1897 to 1907.

	Mo	Month.				1897.	1898.	1899.	1900.	1961.	1968.	1903.	1904.	1905.	1906.	1907.	Mean for 11 Years, 1897-1907.
January,					•	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000	1,265,000	659,000	1,266,000	1,132,000	1,458,000	1,202,000
February,		•	•	•	•	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000	2,133,000	927,000	452,000	1,027,000	692,000	1,335,000
March, .		•	•	•	•	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000	3,423,000	3,008,000	3,004,000	1,860,000	1,697,000	2,913,000
April, .		•	•	•	•	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000	2,238,000	2,984,000	1,617,000	2,109,000	1,436,000	2,376,000
May,		•	•	•	•	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000	269,000	1,498,000	445,000	1,533,000	965,000	1,233,000
June, .		•	•	•	•	1,181,000	828,000	561,000	578,000	986,000	410,000	2,131,000	762,000	542,000	1,184,000	773,000	908,000
July, .		•	•	•	•	1,442,000	333,000	354,000	217,000	477,000	292,000	624,000	497,000	365,000	728,000	335,000	515,000
August, .		•	•	•	•	896,000	1,325,000	236,000	197,000	512,000	297,000	474,000	355,000	321,000	591,000	87,000	481,000
September,			•	•	٠	380,000	676,000	250,000	127,000	320,000	241,000	375,000	494,000	1,228,000	277,000	810,000	471,000
October,	•		•	•	٠	243,000	1,509,000	245,000	282,000	647,000	950,000	000'689	347,000	367,000	530,000	1,382,000	654,000
November,		•	•	•	•	1,283,000	2,170,000	480,000	875,000	517,000	635,000	634,000	343,000	442,000	749,000	2,540,000	965,000
December,			•	•	•	2,275,000	2,061,000	359,000	1,570,000	8,234,000	1,848,000	954,000	440,000	1,018,000	794,000	1,961,000	1,501,000
Average for year, .	for y	ear, .	•	•	•	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000	1,285,000	1,025,000	926,000	1,043,000	1,180,000	1,212,000
Average for driest	for d	riest (	6 months,	oths,	•	886,000	1,013,000	312,000	377,000	576,000	471,000	626,000	413,000	541,000	613,000	725,000	000'899
																_	

1 The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902, inclusive, to 2.4 per cent. in 1908, to 3.6 per cent. in 1907.

Table No. 8. — Yield of the Sudbury Watershed in Gallons per Day per Square Mile 1 from 1875 to 1907.

January,         103,000         643,000         1,810,000         1,180,000         1,1		Мокт	TH.				1875.	1876.	1877.	1878.	1879.	1880.	1881.	1888.	1883.	1884.	1885.
y.         3.         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,486,000         1,584,000 <th>January, .</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>108,000</th> <th>643,000</th> <th>658,000</th> <th>1,810,000</th> <th>700,000</th> <th>1,120,000</th> <th>415,000</th> <th>1,241,000</th> <th>335,000</th> <th>995,000</th> <th>1,285,000</th>	January, .						108,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,285,000
ET.         1,604,000         4,504,000         4,514,000         3,530,000         1,604,000         3,589,000         1,604,000         3,589,000         1,604,000         3,589,000         1,604,000         3,504,000         1,614,000         3,604,000         1,611,000         3,116,000         1,614,000         1,614,000         2,899,000         1,816,000         1,114,000         1,11	February, .				•		1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000
et.         3,949,000         3,392,000         1,592,000         1,592,000         1,169,000         1,164,000         1,646,000         867,000         1,350,000         3,504,000         1,185,000         1,392,000         2,394,000         1,114,000         514,000         965,000         1,292,000         867,000         1,0           1.         1.         870,000         222,000         567,000         138,000         175,000         175,000         1,395,000         867,000         1,0	March,				•	•	1,604,000	4,485,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000
et.	April,				•	•	3,049,000	3,292,000	2,394,000	1,626,000	8,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000
er,	Мау,				•	•	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	987,000	1,030,000	1,336,000
er,	June,	•		•	•	•	870,000	222,000	597,000	206,000	413,000	175,000	1,338,000	529,000	800,000	416,000	426,000
C	July,				•		321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000
Composition         1302,000         184,000         69,000         161,000         141,000         80,000         197,000         907,000         91,000           1         3         466,000         234,000         631,000         1148,000         166,000         71,000         108,000         289,000         186,000         186,000         186,000         186,000         186,000         186,000         186,000         205,000         186,000	August, .				•	•	396,000	405,000	121,000	476,000	395,000	119,000	148,000	25,000	19,000	257,000	240,000
	September, .			•	•	•	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000
	October, .				•	•	646,000	234,000	631,000	516,000	71,000	102,000	186,000	289,000	186,000	83,000	336,000
	November, .			•	•	•	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000
6 months, 972,000 1,135,000 502,000 532,000 230,000 143,000 211,000 1150,000 145,000 143,000 111,000 1150	December, .				•	•	284,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000
6 months, , 674,000 384,000 602,000 230,000 143,000 330,000 211,000 145,000	Average for	· year,	•	•	•	•	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	,533,000	1,129,000	901,000
	Average for	drles		onthe		•	674,000	384,000	502,000	532,000	230,000	143,000	830,000	211,000	145,000	200,000	391,000

1 The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and subsequently increased by the construction of storage reservoirs to 8.0 per cent. in 1879, 8.4 per cent. in 1885, 3.9 per cent. in 1894 and 6.5 per cent. in 1895. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Table No. 8. — Yield of the Sudbury Watershed in Gallons per Day per Square Mile' from 1875 to 1907 — Continued.

Month.			1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
January,			. 1,461,000	2,589,000	1,063,000	2,782,000	1,254,000	8,018,000	1,870,000	434,000	000'889	1,034,000	1,084,000
February,	•		. 4,801,000	2,829,000	1,950,000	1,196,000	1,529,000	3,486,000	943,000	1,542,000	991,000	241,000	2,676,000
March,	•		. 2,059,000	2,868,000	3,238,000	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000
April,	•		1,947,000	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000
Мау,	•	•	. 720,000	1,009,000	1,632,000	000,088	1,366,000	183,000	1,259,000	2,883,000	840,000	636,000	360,000
June,	•		. 203,000	413,000	421,000	658,000	268,000	413,000	428,000	440,000	419,000	174,000	399,000
July,	•	•	. 116,000	115,000	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000
August,	•	•	. 94,000	214,000	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	329,000	67,000
September,	•		. 117,000	111,000	1,155,000	823,000	457,000	203,000	229,000	108,000	150,000	000'68	388,000
October,	•		. 146,000	190,000	1,999,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000
November,	•		. 673,000	369,000	2,758,000	1,941,000	1,215,000	305,000	697,000	319,000	886,000	2,777,000	659,000
December,	٠		1,020,000	643,000	3,043,000	2,241,000	000'966	544,000	485,000	796,000	716,000	1,782,000	657,000
Average for year,	٠		1,087,000	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000
Average for driest 6 mo	6 months,		. 223,000	234,000	963,000	944,000	747,000	239,000	327,000	287,000	356,000	460,000	314,000

1 The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, in 1888. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1873, 8.4 per cent. in 1885, 3.9 per cent. in 1884 and 6.5 per cent. water surfaces.

Table No. 8.— Yield of the Sudbury Watershed in Gallons per Day per Square Mile 1 from 1875 to 1907 — Concluded.

Monte.	TH.			1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	Mean for 33 Years, 1875-1907.
January,				. 845,000	1,638,000 2,288,000	2,288,000	794,000	437,000	1,763,000	1,736,000	477,000	477,000 1,410,000	1,128,000	1,351,000	1,224,000
February,	•			. 1,067,000	3,022,000	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000	330,000	1,041,000	624,000	1,753,000
March,	•			2,565,000	2,604,000	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,999,000	2,497,000	2,409,000	1,658,000	2,914,000
April,	•			. 1,515,000	1,829,000	2,521,000	1,350,000	4,204,000	1,885,000	2,261,000	8,294,000	1,643,000	1,949,000	1,607,000	2,081,000
Мау,	•	•		915,000	1,246,000	911,000	1,312,000	2,954,000	743,000	351,000	1,745,000	297,000	1,059,000	888,000	1,106,000
June,	•	•		. 962,000	530,000	99,000	316,000	753,000	308,000	1,987,000	119,000	467,000	707,000	761,000	533,000
July,	•			. 658,000	231,000	19,000	-18,000	806,000	99,000	445,000	62,000	177,000	398,000	000'6	193,000
August,	•	•		. 591,000	1,107,000	-35,000	-34,000	424,000	135,000	307,000	170,000	114,000	180,000	-104,000	270,000
September,	•			. 182,000	369,000	94,000	65,000	305,000	178,000	130,000	397,000	1,246,000	19,000	541,000	271,000
October,	•			. 94,000	1,180,000	115,000	186,000	412,000	206,000	492,000	191,000	158,000	301,000	741,000	496,000
November,	•			. 909,000	1,986,000	304,000	000'899	474,000	444,000	363,000	000'687	279,000	488,000	1,998,000	873,000
December,	•			1,584,000	1,799,000	220,000	1,096,000	2,695,000	1,779,000	282,000	269,000	887,000	659,000	2,032,000	1,092,000
Average for year,				. 991,000	1,450,000	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000	795,000	860,000	1,010,000	1,063,000
Average for driest	est six	six months,	ths,	. 564,000	777,000	93,000	194,000	445,000	271,000	388,000	228,000	403,000	341,000	471,000	438,000

1 The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878, inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 8.4 per cent. in 1884, 3.9 per cent. in 1884 and 6.5 per cent. in 1889 and 6.5 per cent. in 1889. In watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Table No. 9.—Wachusett System.—Statistics of Flow of Water, Storage and Rainfall in 1907. [Watershed above gaging station = 119.00 square miles.]

Parcent-	age of Rainfall collected.	91.6	. 48.0	166.3	93.5	58.3	37.7	19.7	12.4	14.7	43.4	76.4	79.5	,	54.2
	Rainfall collected (Inches).	2.601	1.115	3.028	2.479	1.722	1.334	0.597	0.155	1.399	2.465	4.384	3.499	24.778	
	Rainfall (Inches).	2.8	2.32	1.82	2.65	2.96	3.54	3.03	1.26	9.50	5.68	5.74	4.40	45.74	•
Total Viald	of Watershed (Gallons per Day).	173,561,000	82,325,000	201,994,000	170,857,000	114,894,000	92,003,000	39,845,000	10,368,000	96,420,000	164,455,000	302,227,000	233,413,000		140,396,000
1.68.1	Loss (Gallons per Day).	1	29,686,000	ı		12,271,000	,	64,581,000	77,361,000	,	ı	ı	ı	-	1
STORAGE.	Gain (Gallons per Day).	78,019,000	1	115,152,000	60,733,000	1	6,470,000	'	ı	45,657,000	107,806,000	244,663,000	167,855,000	-	53,829,000
Quantity of	into River below Dam (Gallons per Day).	3,887,000	3,604,000	3,752,000	3,813,000	3,758,000	4,357,000	4,355,000	3,142,000	3,743,000	4,158,000	4,600,000	4,548,000		8,978,000
Quantity of	charged through Wachusett Aqueduct (Gal- lons per Day).	91,655,000	108,407,000	83,090,000	106,310,000	123,406,000	81,177,000	100,071,000	84,587,000	47,020,000	52,490,000	52,963,000	61,010,000	1	82,589,000
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		•	•	•	٠	•	•	•	•	•	•	•	•	•	for 3
		January, .	February, .	March, .	April,	Мау,	June,	July,	August, .	September, .	October, .	November, .	December, .	Total, .	Average for year,

1 Aggregate storage in Wachusett Reservoir and in ponds and mill reservoirs.

[Watershed from 1875 to 1578 inclusive = 77.764 square miles; in 1879 and 1880= 78.288 square miles; and from 1881 to 1907 inclusive = 75.28 square miles.] Table No. 10.—Sudbury System.—Statistics of Flow of Water, Storage and Rainfall in 1907.

Quantity of Water dis-	Quantity of Water dis-	Qua Wal	Quantity of Water dis-	Quantity of Water	Quantity of Water	Quantity of Water wasted	STORAGE	AGE.	Total		Doinfell	Percent
uct ton er (G	through Sud- bury Aqueduct (Gallons per Day).		Wes- leduct ls per ).1	Framingham Water Com- pany (Gallons per Day).	Watershed by Sewers, etc. (Gallons per Day).	below Lowest Dam (Gallons per Day).	Gallons per Day).	Loss (Gallons per Day).	Watershed (Gallons per Day).	Rainfall (Inches).	collected (Inches).	age of Rainfall collected.
91,655,000 97,942,000 31,45		31,45	31,452,000	645,000	1,765,000	71,981,000	1	10,506,000	10,506,000 101,623,000	3.28	2.411	73.4
108,407,000 103,046,000 31,521,000		31,52	000,1	725,000	1,361,000	51,111,000	ı	32,454,000	46,904,000	2.17	1.005	46.3
83,090,000 90,226,000 80,751,000		30,751	000,	632,000	1,961,000	64,665,000	19,545,000	,	124,690,000	1.91	2.958	154.6
106,310,000 92,777,000 29,070,000		29,070,	98	657,000	1,963,000	72,303,000	30,407,000	1	120,867,000	3.41	2.774	81.5
123,406,000 92,452,000 30,245,000		30,245,0	8	597,000	1,261,000	27,848,000	37,761,000	1	66,758,000	3.63	1.584	43.6
81,177,000 84,020,000 31,187,000		31,187,0	8	610,000	1,100,000	23,640,000	ı	2,123,000	57,257,000	3.53	1.314	37.2
100,071,000 80,881,000 31,055,000		31,055,0	8	639,000	539,000	1,500,000	ı	13,881,000	661,000	1.86	0.015	0.0
84,587,000 77,890,000 30,771,000		30,771,0	8	661,000	452,000	1,500,000	1	34,526,000	-7,839,000	1.07	-0.186	-17.4
47,020,000 73,027,000 29,953,000		29,953,0	8	290,000	760,000	1,500,000	1	18,277,000	40,683,000	8.76	0.934	10.7
52,490,000 84,942,000 30,126,000	,	30,126,0	8	574,000	1,045,000	1,513,000	1	10,010,000	55,700,000	4.17	1.321	31.7
52,963,000 73,730,000 29,757,000		29,757,0	8	241,000	1,717,000	56,003,000	41,470,000	1	150,260,000	6.12	3.450	56.4
61,010,000 88,568,000 29,416,000		29,416,0	8	494,000	2,081,000	73,110,000	20,116,000	1	152,774,000	4.47	3.624	81.1
1		1			ı	1	1	t	ı	44.38	21.204	1
82,589,000 86,553,000 30,438,000	-	30,438,0	8	613,000	1,333,000	37,096,000	2,463,000	1	75,918,000	ı	ı	47.8

1 Including quantity of water wasted from aqueduct.

Table No. 11.—Cochituate System.—Statistics of Flow of Water, Storage and Rainfall in 1907.

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Paragraphic Continum Water			Quantity of	Quantity of Water	Quantity of Water diverted	Quantity of	Bros	STORAGE.	Total Yield			Percent
	Монтн.		received from External Sources (Gal- lons per Day). <sup>2</sup>		from Water- shed by Sewers, etc. (Gallons per Day).	Water wasted at Outlet (Gallons per Day).	Gain (Gallons per Day).	Loss (Gallons per Day).	of Water- shed (Gallons per Day).	Rainfall (Inches).	Kainfail collected (Inches).	age of Rainfall collected.
	January,		t		781,000	1	19,284,000	-	20,065,000	3.14	1.90	60.4
14,489,000       877,000       -       9,816,000       -       2,816,000       -       2,816,000       -       2,816,000       -       2,816,000       -       2,816,000       -       2,816,000       -       2,816,000       -       2,816,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       11,283,000       -       8,783,000       -       8,783,000       -       8,783,000       -       8,783,000       -       -       8,783,000       -       -       8,783,000       -       -       -       8,783,000       -	February,		ı	6,568,000	593,000	ı	3,846,000	,	11,007,000	2.18	<b>7</b> 6.0	48.1
	March,	•	ı	14,439,000	877,000	ı	9,816,000	,	25,132,000	1.88	2.38	126.4
774,000     14,325,000     - <td>April,</td> <td></td> <td>ı</td> <td>6,237,000</td> <td>1,203,000</td> <td>7,147,000</td> <td>9,363,000</td> <td>'</td> <td>23,950,000</td> <td>3.47</td> <td>2.19</td> <td>8.1</td>	April,		ı	6,237,000	1,203,000	7,147,000	9,363,000	'	23,950,000	3.47	2.19	8.1
8,283,000     697,000     6,900,000     -     4,700,000       15,484,000     374,000     -     -     14,545,000       24,115,000     184,000     -     -     21,223,000       1     -     20,100,000     283,000     -     8,745,000       1     -     24,487,000     -     8,745,000     -       1     -     2,487,000     -     -       1     -     8,389,000     1,990,000     -     22,487,000       1     -     8,389,000     1,226,000     -     25,823,000       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -     -     -     -     -       1     -	Мау,	•	1	ı	774,000	14,326,000	ı	,	15,100,000	3.62	1.43	39.4
374,000     374,000     -     -     14,545,000       15,484,000     184,000     -     -     21,223,000       18,745,000     263,000     -     -     2,487,000       18,690,000     526,000     -     2,487,000     -       18,690,000     1,090,000     -     2,487,000     -       18,748,000     1,090,000     -     2,487,000     -       18,748,000     1,090,000     -     25,823,000     -       18,748,000     1,226,000     -     25,823,000     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,226,000     -     -     -       18,748,000     1,227,000 <td< td=""><td>June,</td><td>•</td><td>1</td><td>8,203,000</td><td>597,000</td><td>6,900,000</td><td>ı</td><td>4,700,000</td><td>11,000,000</td><td>2.89</td><td>1.01</td><td>8.4.8</td></td<>	June,	•	1	8,203,000	597,000	6,900,000	ı	4,700,000	11,000,000	2.89	1.01	8.4.8
	July,		ı	15,484,000	374,000	ı	ı	14,545,000	1,313,000	1.45	0.13	8.6
	August,		ı	24,116,000	184,000	1	1	21,223,000	3,077,000	1.27	0.29	22.9
9,748,000 18,690,000 526,000 - 2,497,000 - 20,113,000 - 20,113,000 - 20,810,000 1,090,000 - 20,113,000 - 20,113,000 - 20,113,000 - 25,823,00	September,		ı	20,100,000	263,000	1	ı	8,753,000	11,610,000	7.62	1.06	13.9
	October,	•	9,748,000	18,690,000	526,000	1	2,497,000	1	11,965,000	3.96	1.13	8.e 8.e
6	November,	•	13,020,000	20,610,000	1,090,000	ı	20,113,000	1	28,783,000	5.63	2.63	8.94
e for year 1.888 000 11.487 000 707 000 2.871 000 2.871 000 -	December,		ı	8,339,000	1,226,000	1	25,823,000	1	30,887,000	3.66	2.87	78.5
1 898 000 11 497 000 707 000 8.451 000 -	Total,	•	ı	,	1	1	,	,		40.77	17.95	,
	Average for year,		1,898,000	11,497,000	707,000	2,371,000	8,451,000	1	16,129,000	1	•	0.4

1 Not including the watershed of Dudley Pond.

<sup>2</sup> From Framingham reservoirs Nos. 1, 2 and 3.

						FRAMING	FRAMINGHAM RESERVOIR	ERVOIR.					
	Chestput	Lake			Weston				Ashland	Sudbury	Hopkinton	Whitehall	Wachusett
DATE.	Reservoir.	ş	Farm Pond.	Spot Pond.	Reservoir.	No. 1.	No. 2.	No. 3.	Reservoir.	Reservoir.	Reservoir.	Reservoir.	Reservoir.
	Ordinary High Water = 134.00.	High Water = 144.36.	High Water = 159.25.	High Water = 163.00.	High Water = 200.00.	Flash Boards 169.27.	Flash Boards 177.12.	Flash Boards 186.50.	Flash Boards 225.23.	Flash Boards 259.97.	Flash Boards 305.00.	Ordinary High Water = 337.91.	Ordinary High Water = 395.00.
Jan. 1, 1907, .	134.46	138.56	159.92	162.89	200.26	168.31	176.56	183.69	224.80	256.45	303.00	337.05	364.57
Feb. 1, 1907, .	131.99	141.45	159.24	162.27	200.03	167.84	176.17	183.90	224.46	255.88	304.22	336.35	367.30
Mar. 1, 1907, .	132.69	141.94	159.16	159.79	200.03	167.85	176.17	183.09	221.96	255.14	301.01	335.19	366.54
April 1, 1907, .	133.12	143.27	159.08	160.91	200.03	167.89	176.19	183.23	224.22	255.51	304.18	232.92	370.28
May 1, 1907, .	134.08	144.39	158.98	162.44	200.00	167.85	176.18	184.00	224.54	257.09	304.25	336.98	372.32
June 1, 1907, .	134.19	144.39	158.87	163.25	199.92	169.50	177.31	183.61	225.39	25.9.22	306.25	337.48	372.02
July 1, 1907, .	133.23	143.84	158.68	163.21	200.08	169.21	176.00	182.56	225.38	259.33	305.12	337.80	372.41
Aug. 1, 1907, .	131.59	141.91	158.25	163.20	200.00	168.57	176.31	183.65	224.61	259.16	299.88	337.55	370.47
Sept. 1, 1907, .	181.69	138.77	157.79	163.20	200.08	168.20	176.11	185.00	211.98	259.17	291.38	337.18	368.07
Oct. 1, 1907, .	132.68	137.38	158.20	163.26	200.24	169.31	176.81	184.45	200.09	259.44	290.62	337.79	368.91
Nov. 1, 1907, .	183.73	137.80	158.28	163.10	200.08	169.20	177.80	182.12	203.49	258.44	284.25	337.89	372.52
Dec. 1, 1907, .	131.96	140.81	158.65	163.19	,200.04	167.92	177.44	182.98	212.49	259.48	293.48	338.36	379.81
Jan. 1, 1908, .	134.05	144.27	158.99	163.04	200.00	168.01	176.31	182.20	220.48	259.65	300.66	337.63	384.31

Table No. 13.—Sources from which and Periods during which Water has been drawn for the Supply of the Metropolitan Water District.

```
From Wachusett Reservoir into Sudbury Reservoir.
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7:00 A.M. Jan. 1 to 11:00 A.M. Sept. 24.
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Total quantity, 30,145,100,000 gallons.

From Sudbury Reservoir through the Weston Aqueduct to the Weston Reservoir.

Total quantity, 11,077,600,000 gallons.

From Framingham Reservoir No. 2 through Sudbury Aqueduct to Chestnut Hill Reservoir.
7:00 A.M May 14 to 12:00 M. Oct 12.

Total quantity, 4,280,000,000 gallons.

From Framingham Reservoir No. 3 through Sudbury Aqueduct to Chestnut Hill Reservoir.

```
7:00 A.M. Jan. 1 to 12:00 M. Oct. 12.
```

Total quantity, 26,619,000,000 gallons.

From Lake Cochituate through Cochituate Aqueduct to Chestnut Hill Reservoir.

```
1:00 P.M. Feb. 12 to 4:00 P.M. Apr. 9.
```

Total quantity, 4,160,300,000 gallons.

From Framingham Reservoir No. 1 to Lake Cochituate.

```
2:00 P.M. Oct. 12 to 10:30 A.M. Oct. 15.
```

1:45 P.M. Nov. 2 " 7:00 A.M. Nov. 6. . Total quantity, 344,300,000 gallons.

From Framingham Reservoir No. 2 to Lake Cochituate.

```
2:00 P.M. Oct. 12 to 10:30 A.M. Oct. 15.
```

1:45 P.M. Nov. 2 " 7:00 A.M. Nov. 6. Total quantity, 311,200,000 gallons. From Framingham Reservoir No. 3 to Lake Cochituate.

10:30 A.M. Oct. 15 to 11:30 A.M. Oct. 15.

7:00 A.M. Nov. 6 " 8:00 A.M. Nov. 6. Total quantity, 37,300,000 gallons.

From Hopkinton Reservoir to Framingham Reservoir No. 2.

12:00 m. July 11 to 11:20 A.m. Sept. 23.

10:30 A.M. Sept. 25 " 10:40 A.M. Sept 29. Total quantity, 1,165,400,000 gallons.

From Ashland Reservoir to Framingham Reservoir No. 2.

5:30 P.M. July 23 to 7:00 A.M. July 27.

11:00 a.m. Aug. 2 " 11:00 a.m. Sept. 4.

11:00 A.M. Sept. 5 " 10:30 A.M. Sept. 10.

10:00 A.M. Sept. 11 " 11:00 A.M. Sept. 23.

10:30 A.M. Sept. 25 " 7:00 A.M. Sept. 29 Total quantity, 1,222,900,000 gallons.

TABLE No. 14.—Average Daily Quantity of Water flowing through Aqueducts in 1907 by Months.

										Wachusett			SUDBURY AQUEDUCT INTO CHRSTNUT HILL RESERVOIR	HILL RESERVOIR.	Cochituate
			Ř	Монтн.						Aqueduct into Sudbury Reservoir (Gallons).	Aqueduct into Metro- politan District (Gallons).	From Framing ham Reservoir No. 3 (Gallons).	From Framing bam Reservoir No. 2 (Gallons).	Total (Gallons).	Aqueduct into Chestaut Hill Reservoir (Gallons).
January, .	•	•	•	•	•	•	•	•	•	91,655,000	31,452,000	97,942,000	ı	97,942,000	1
February, .	•	•	•	•	•	•	•	•	•	108,407,000	31,521,000	130,046,000	1	103,046,000	6,568,000
March, .	•	•	•	•	•	•	•	•	•	83,090,000	30,752,000	90,226,000	1	90,226,000	14,439,000
April,	•	•	•	•	•	•	•	•	•	106,810,000	27,993,000	92,777,000	,	92,777,000	5,567,000
Мау,	•	•	•	•	•	•	•		•	123,406,000	30,245,000	84,571,000	7,881,000	92,452,000	
June,	•	•	•	•	•	•	•		•	81,177,000	81,187,000	67,720,000	16,300,000	84,020,000	8,203,000
July,	•	•	•	•	•	•	•	•	•	100,071,000	81,055,000	61,116,000	19,765,000	80,881,000	15,484,000
August, .	•	•	•	•	•	•	•		•	84,587,000	30,771,000	39,384,000	38,506,000	77,890,000	24,116,000
September, .	•	•	•	•	•	•	•	•	•	47,020,000	29,953,000	29,967,000	43,060,000	73,027,000	20,100,000
October, .	•	•	•	•	•	•	•		•	52,490,000	30,126,000	60,726,000	14,468,000	75,194,000	18,690,000
November, .	•	•	•	•	•	•	•	•	•	52,963,000	29,757,000	60,710,000	ı	60,710,000	20,413,000
December, .	•	•	•	•	•	•	•	•	•	61,010,000	29,416,000	88,568,000	1	88,568,000	3,010,000
Average,	•	•	•	•	•	•	•	•	•	82,589,000	80,350,000	72,929,000	11,726,000	84,655,000	11,398,000

1 Not including quantities wasted while cleaning and repairing aqueducts, and not including 1,898,000 gallons per day diverted through the Sudbury Aqueduct to Lake Cochituate, and 2,740 gallons per day diverted to Farm Pond.

TABLE No. 15. — Statement of Operations of Engines Nos. 1 and 2 at Chestnut Hill High-service Pumping Station for the Year 1907. [3 per cent. allowed for slip.]

			_	ENGINE	No. 1.	Ä	ENGINE	No. 2.		-uo	br.	891	, [ac		.,	to noi	10 -90 -90
Моитн.	ri.			Time.	Amount pumped, corrected for Blip (Million Gallons).	Saiqmu IstoT	Time.	Amount pumped, corrected for Slip (Million Gallons).	nom A latoT limi) beqmrq (anollat).	o fact of Coal of Canda (Pounda)	s adah to taromh Danoya (Pounding	Per Cent. of Asl and Clinkers.	Quantity pump per Pound of Co no Deduction Heating or Lig ing (Gallons).		Average Lift (Feet	Duty in Foot-pour per 100 Pounds Coal, no Deducti for Heat ing Lighting; correct for Silp.	Duty in Foot-pour per 100 Pounds Coal, on Basis Plunger Displa ment, no Dedi tion for Heating Lighting.
January, .			Hrs.	4. Min.	60.63	Hrs. 3	Min. 50	128.11	188.74	365,470	46,643	12.8	516.43	No. 1. 123.09	No. 2. 122. 25	52,700,000	54,340,000
February, .		•	 	30	105.35	808	10	114.58	219.93	398,907	56,354	14.1	551.47	124.45	124.86	57,280,000	59,040,000
March, .		•		3 20	34.75	<b>4</b> 05	45	147.41	182.16	314,734	40,861	13.0	578.77	126.74	124.70	60,310,000	62,190,000
April,			 	22	20.35	313	8	113.31	133.66	215,613	24,710	11.6	16.619	120.57	122.11	62,930,000	64,890,000
May,		•	 	92 8	23.25	338	ĸ	122.57	145.82	212,307	23,828	11.2	18.989	120.25	121.87	69,580,000	71,740,600
June,			- 250	0+	89.67	123	10	79.20	168.87	216,007	26,014	12.0	781.78	120.46	120.85	78,570,000	81,010,000
July,				•	,	88	15	223.62	223.62	289,822	34,826	13.0	771.58	,	120.72	77,570,000	79,990,000
August, .			151	90	56.91	495	8	183.49	240.40	350,393	47,075	13.4	686.09	120.88	122.06	000,000,69	71,770,000
September, .			- 60	1 25	209.63	'	ı	1	209.63	344,691	43,715	12.7	608.14	121.01	•	61,300,000	63,210,000
October, .				1 25	199.22	1	1	1	199.22	353,442	41,811	11.8	563.46	120.63	ı	56,640,000	58,400,000
November, .			202	20	164.68	'	,	1	164.68	312,274	41,064	13.1	527.36	120.38	1	52,880,000	54,520,000
December, .			. 48	- 0	168.97	'	_	1	158.97	286,148	36,502	13.3	597.30	118.87	ı	59,140,000	000'086'09
Total, .			3,250	88	1,123.40	3,048	33	1,112.29	2,235.69	3,639,708	462,403	•	ı			ı	
А verage,		•		1	1	' 	ı	1	•	•	,	12.7	614.25	121.15	122.15	62,240,000	64,180,000

TABLE No. 16.—Statement of Operations of Engine No. 3 at Chestnut Hill High-service Pumping Station for the Ye ir 1907.

[7.5 per cent. allowed for slip]

Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plebacement, no Deduction for Heating or Lighting.	114,660,900	•	117,490,000	119,110,000	114,900,000	1	ı	117,870,000	102,400,000	1	119,780,000	1	  -  -	117,180,000
Duty in Foot-pounds of Port 100 Pounds of Coal, no Deduction for Hearing or Lighting; corrected lor Slip.	106,120,000	1	108,740,000	110,240,000	106,340,000	ı	ı	109,090,000	94,770,000	1	110,810,000	1		108,400,000
Average Lift (Feet).	126.61	ı	131.10	129.38	184.98	1	•	130.47	122.92	1	125.03	1		129.16
Quantity pumped for the per Pound of Coal, no Deduction for Hearing or Light-ing (Gallons).	1,006.15	1	985.78	1,022.86	945.73	1		1,003.75	925.55	1	1,063.92	,		1,007.52
Per Cent. of Ashes and Clinkers.	15.6		10.9	11.9	9.4	1	,	12.8	19.1	,	17.3	1		13.2
Amount of Ashessad Clinkers (Pounds).	3,700	1	5,332	3,148	2,854	1	1	3,279	920	1	8,158	ı	27,421	1
-mount of Coal con- .(Sounda) beamna	23,734	1	49,088	26,514	30,368	1	ı	25,594	5,910	ı	47,156	ı	208,364	1
, bed m uq tunmA qils qire o'tocorocorocorocorocorocorocorocorocoroco	33.88	1	48.88	27.12	28.72	1	1	55.69	2.47	1	50.17	•	209.93	ı
some Sandam vanov	Min. 35	,	45	25	8	ı	'	50	ı	,	8	1	22	1
.emiT gaiqanaf lestoT	Hrs. 26	٠	23	88	80	'	1	83	9	1	s	•	227	1
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	January,	February,	March,	A pril, .	Мау,	June, .	July, .	August,	September,	October,	November,	December,	Total, .	Average,

TABLE No. 17. - Statement of Operations of Engine No. 4 at Chestnut Hill High-service Pumping Station for the Year 1907. [3 per cent. allowed for slip.]

A distribution of the control of the	36.31	38.48	35.72	34.38	34.90	36.14	87.84	89.00	37.37	36.84	35.33	35.58	,	36.43
and the state of t	1,125.61	1,075.99	1,107.36	1,080.98	1,082.00	1,084.13	1,157.55	1,209.02	1,121.15	1,142.11	1,059.81	1,102.98	13,298.59	ı
Duty in Foot-pounds of Foot on Bease of Foot on Bease of Foot on Bease of Foot on Beating or tion for Heating or Lighting.	138,560,000	140,350,000	137,000,000	189,180,000	137,600,000	133,240,000	136,420,000	147,770,000	140,920,000	138,830,000	137,120,000	121,190,000	•	137,050,000
Duty in Foot-pounds of Too Pounds of Cosl, no Deduction for H oo Lighting; corrected for Slip.	134,430,000	136,160,000	132,910,000	135,030,000	133,490,000	129,260,000	132,350,000	143,360,000	136,710,000	134,690,000	133,030,000	117,570,000		132,960,000
Average Lift (Feet).	131.23	132.03	181.91	132.08	130.99	130.35	130.42	131.85	183.25	133.28	132.88	131.29		131.79
Quantity pumped per Pound of Coal, no Deduction for Heating or Light-ing (Gallons).	1,229.69	1,238.02	1,209.57	1,227.81	1,223.41	1,190.45	1,218.25	1,305.30	1,231.69	1,213.16	1,201.82	1,075.02		1,211.13
Per Cent. of Ashes	13.4	14.6	13.8	12.7	14.5	13.6	12.9	14.5	14.7	14.3	14.8	13.3		13.9
Amount of Ashes and Clinkers (Pounds).	99,513	101,252	99,694	810,06	107,560	104,180	180,66	104,980	108,256	110,946	103,758	116,525	1,245,763	ı
-noo leed of Coal con-	742,454	691,479	724,489	708,991	741,749	768,836	766,615	722,386	735,625	777,218	703,069	878,089	8,961,000	ı
, b e q m u q tmomA qitg tot beteertoo .(anolfæb noifliM)	912.99	856.06	876.32	870.15	907.46	915.26	933.93	942.93	90.908	942.89	844.96	943.96	10,852.97	٠.
	Min.	1	46	10	83	1	22	23	22	•	33	35	10	1
.emiT gaiqmu¶ ladoT	Hrs. 715	672	689	989	713	730	73	716	713	744	88	743	8,515	1
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Month.	•	٠	•	•	•	•	٠	•	•	•	•	•	•	•
	•	•	•	•	•	•	•	•	•	•	•	•	•	e.
	January,	February,	March, .	April, .	Мау, .	June, .	July, .	August, .	September,	October,	November,	December,	Total,	Average, .

Table No. 18.—Statement of Operations of Engines Nos. 5, 6 and 7 at Chestnut Hill Low-service Pumping Station for the Year 1907.

[3 per cent. allowed for slip.]

-ai no		111,580,000	110,440,000	117,250,000	112,910,000	110,040,000	109,500,000	110,770,000	114,720,000	108,170,000	109,470,000	96,540,000	101,060,000		109,890,000
ou ou	Duty in Foot-pounds p 100 Pounds of Cosl, 100 Pounds of Cost, 100 Deduction for Hesting; corrects for Silp.	108,280,000	107,170,000	113,780,000	109,570,000	106,780,000	106,260,000	107,490,000	111,320,000	104,970,000	106,230,000	98,680,000	98,070,000		106,640,000
TAI	Engine No. 7.	58.93	57.75	61.81	56.75	53.95	52.80	55.45	55.93	,	ı	42.79	ı	•	56.44
AVERAGE LIFT	Engine No. 6.	59.37	57.01	61.44	54.76	54.47	58.65	54.74	58.62	50.89	91.00	48.83	48.20	•	54.50
ΑVI	Engine No. 5.	29.62	88.89	62.11	54.90	53.18	53.16	91.99	67.50	50.47	50.17	17.74	48.56	-	68.69
19 -90 10	Quantity pumped p Pound of Coal, no I duction for Heating Lighting (Gallone).	2,185.41	2,217.35	2,211.97	2,381.50	2,373.40	2,407.90	2,324.90	2,326.79	2,486.80	2,521.71	2,349.74	2,438.54		2,340.45
pu	Per Cent. of Ashes a: Clinkers.	13.0	14.2	13.1	13.1	13.3	14.3	14.9	12.8	14.7	15.6	15.6	15.2	'	14.0
- <b>u</b> o	Total Amount of Coal co sumed (Pounds).	904,765	865,835	942,260	764,034	755,046	686,320	769,790	790,646	636,900	653,530	626,090	662,045	9,057,261	•
t n -[s:	Daily Average Amou: Pumped (Million Ginon).	64.075	994.89	67.234	60.652	57.807	55.087	57.732	59.34	52.795	53.162	49.038	178.19		58.077
рə	Total Amount pump of m p of m p of m p of m b of m of the contract of m p of m b of m of m b	1,986.33	1,919.87	2,084.25	1,819.55	1,792.03	1,652.59	1,789.68	1,839.67	1,583.84	1,648.01	1,471.15	1,611.11	21,196.08	•
No. 7.	Amount pumped, corrected for Slip (Mil-lion Gallone).	825.85	593.84	688.85	386.58	797.77	836.10	668.57	538.87	ı	ı	49.55	,	5,386.38	'
ENGINE	Total Fumping Time.	Hrs. Min. 663 35	485 19	571 15	823 20	- 199	675 40	547 40	436 35	1	1	42 40	1	4,397 04	1
No. 6.	Amount pumped, corrected for Slip (Mil-liones).	855.96	792.86	815.52	808.92	677.93	1.40	491.51	650.63	775.82	789.34	673.60	803.67	8,147.15	'
Engine	.emiT gaiqana fasoT	Hrs. Min. 691 05	640 35	- 119	682 45	553 45	1 20	408 25	525 50	649 25	656 15	553 55	666 35	6,701 55	•
No. 5.	Amount pumped, corrected for Slip (Mil-lion Gallons).	304.52	533.17	579.88	623.65	316.33	815.09	629.60	650.17	808.02	848.67	748.00	807.44	7,664.54	'
		Ein.	8	18	1	28	2	೫	22	2	ន	16	ຂ	Ħ	1
Engin	Total Pumping Time.	Hrs. Min. 250 55	438 48	<b>48</b>	252	269	657	230	280	<b>5</b> 8	701	616 16	689	6,348 23	۱۰
	<u>.</u>	•	•	•	•	•	•	•	•	۴,	•		<del>'</del> ئ	•	ıge,
	Monte.	January,	February,	March, .	April, .	Мау, .	June, .	July, .	August,	September, .	October,	November, .	December,	Total, .	Average,

TABLE No. 19. - Statement of Operations of Engines Nos. 8 and 9 at Spot Pond Pumping Station for the Year 1907.

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mount latoT  Note of the correction of the corre	111	ı		270 273 273 273 273 273 273 273 273 273 273
Duty in Foot-pounds of Coal, on Basis of Coal, on Basis of Plunger Displacement, no Deduction for Hearing or Lighting.	115,200,000 86,430,000 125,150,000	101,830,000		131,150,000 131,150,000 137,260,000 137,260,000 134,360,000 134,360,000 138,280,000 134,360,000 134,560,000 134,540,000 134,540,000 134,540,000 134,540,000 134,540,000 134,540,000 134,540,000 134,540,000
Duty in Foot-pounds of Cost, no Deduction Cost, no Deduction for H esting or Lighting; corrected for Slip.	112,880,000 84,690,000 122,630,000	99,770,000		127, 150, 000 127, 880, 000 123, 380, 000 121, 187, 700, 100 139, 670, 000 138, 670, 000 138, 680, 000 121, 120, 000 115, 120, 000 115, 120, 000 115, 120, 000
Average Lift (Feet).	129.38 120.94 136.94	127.07	lp.]	127.83 138.64 138.86 138.86 138.86 138.45 139.48 139.48 139.48 139.48 139.48 139.48 139.48
Quantity pumped per Pound of Coal, no Peduction for Heating or Light-ing (Gallons).	1,047.37 840.66 1,075.02	942.52	cent. allowed for slip.	1,194.23 1,183.94 1,121.48 1,125.42 1,118.30 1,288.52 1,188.65 1,168.94 1,168.96 1,062.48 1,062.48 1,062.48 1,062.48
Per Cent. of Ashes and Clinkers.	11.9 15.5 15.1	14.5	ent. all	10.5 13.7 14.1 14.1 14.1 15.0 15.0 15.0 15.0 16.2 16.2
Amount of Ashes and . (Pounda) .	1,405 3,655 1,317	6,377	9, 3 per c	22,736 23,587 33,587 33,587 33,582 27,732 27,732 28,985 28,985 28,985 38,237 38
Amount of Cosl con- sumed (Pounds).	11,820 23,541 8,744	44,105	Engine No.	216,475 234,0612 244,0612 203,782 223,463 223,463 221,534 221,834 225,344 225,344 225,344 225,344
Amount pumped, corrected for Blipped. (Million Gallone).	12.38 19.79 9.40	41.67	<u>ā</u>	258.52 273.75 273.75 229.34 280.107 286.30 256.20 256.20 256.20 256.20 256.20 256.20 256.20 256.20 256.20 256.20 256.20
Total Pumping Time.	Hrs. Min. 28 - 44 - 23 30	95 30		Hrs. Min. 321 30 321 30 324 3282 - 282 305 317 45 55 346 55 317 45 2 15 201 55 201 55 338 45 5 338 45 5 5 338 45 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
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Моитн	• • •	average,		
	January, April, September,	Total or average,		January, February, March, April, May, June, July, Auly, Aught, October, November, December, Total,

TABLE No. 20. — (Meter Basis.) Average Daily Consumption of Water during the Year 1907, in the Cities and Towns supplied by the Metropolitan Water Works, including Boston, Somerville, Chelsea, Malden, Everett, Quincy, Medford, Melrose, Revere, Watertown, Arlington, Lexington, Milton, Stoneham, Winthrop, Swampscott, Belmont, Nahant and a Small Portion of Saugus. (For Consumption of Water in Whole Metropolitan Water District, see Table No. 23.)

	-		M	ONTH	•			Average Daily Consumption (Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
January,								134,725,400	923,060	146
February,							.	146,118,200	924,700	158
March,								128,891,700	926,340	139
April, .								118,269,200	927,980	128
May, .								118,247,400	931,620	127
June, .								121,202,600	935,260	130
July, .								124,211,800	937,900	133
August,								126,575,200	939,390	135
September,								120,233,700	939,870	128
October,								119,337,900	939,360	127
November,								115,385,700	938,850	123
December,								118,142,900	940,330	126
For the	yea	r,						124,135,100	934,730	133

In addition to the above quantities, the United States Government Reservation on Peddocks Island was supplied with 18,068,000 gallons, equivalent to a daily average rate of 50,000 gallons.

Table No. 21. — (Meter Basis.) Average Daily Consumption of Water, in Gallons, from the Low-service System in 1907.

						SOUTHERN LOW SERVICE.	Northern Low Service.	
		Mor	TH.			Boston, excluding East Boston and Charlestown.	Portions of Charles- town, Somerville, Chelses, Everett, Malden, Medford, East Boston and Arlington.	Total Low-service Consumption.
January, .						56,889,400	32,780,800	89,670,200
February,						61,227,100	36,600,300	97,827,400
March, .						54,231,600	30,080,200	84,311,800
April, .						49,334,300	26,069,000	75,403,300
May,						48,809,100	26,013,200	74,822,300
June, .						48,809,600	26,944,700	75,754,300
July,						49,538,400	27,365,000	76,903,400
August, .						49,248,000	28,353,600	77,601,600
September,						48,309,900	26,320,000	74,629,900
October, .						49,279,400	25,818,400	75,097,800
November,						47,986,800	24,745,800	72,732,600
December,						48,756,400	26,419,300	75,175,700
For the year	r,					50,973,100	28,069,200	79,042,300

TABLE No. 22. — (Meter Basis.) Average Daily Consumption of Water, in Gallons, from the High-service and Extra High-service Systems in 1907.

				Southern High Service.	SOUTHERN EXTRA HIGH SERVICE.	Northern High Service.	Northern Extra High Service.
Ж	ONT	н.		Quincy, Water- town, Belmont, and Portions of Boston and Milton.	Portions of Boston and Milton.	Revere, Winthrop, Swampscott, Nahant, Stoneham, Melrose, and Portions of Boston, Chelsea, Everett, Milden, Medford, Somerville, and Small Part of Saugus.	Lexington and Portion of Arlington.
January,		•	•	35,210,900	479,300	8,802,600	562,400
February,				37,297,200	510,0 <b>0</b> 0	9,877,200	606,400
March, .				34,738,000	526,900	8,723,700	591,300
April, .				33,469,700	541,500	8,270,700	584,000
Мау, .				33,761,200	594,500	8,441,300	628,100
June, .				34,623,700	724,900	9,430,700	669,000
July, .				35,666,400	763,900	10,158,300	724,800
August, .				36,630,500	843,100	10,636,500	863,500
September,				35,301,200	645,400	8,995,300	661,900
October,				34,952,400	563,800	8,127,900	596,000
November,				33,814,400	468,400	7,770,700	599,600
December,				34,140,400	468,400	7,813,700	544,700
For the y	ear,			34,949,500	595,600	8,911,900	635,800

Table No. 23.— Average Daily Consumption of Water in Cities and Towns supplied from Metropolitan Works, as measured by Venturi Meters in 1907.

City or town,		Boston	N.	SOMERVILLE.	TLLE.	MALDEN.	EN.	CHELSEA	BA.	EVERETT.	rr.	Quinck	CY.	MEDFORD.	ORD.
Population supplied, .		612,580	80.	72,540.	40.	39,820.	20.	38,650.	50.	31,350.	50.	29,390.	90.	20,700.	
		GALLONS.	NB.	GALLONS.	JN8.	GALLONS.	OMB.	GALLONS.	NB.	GALLONS.	N8.	GALLONS.	JNB.	GALLONS.	NB.
Month.		Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,	•	. 105,697,600	174	7,169,000	100	1,896,500	87	4,966,300	130	2,958,700	96	2,788,700	97	2,161,400	106
February,.		113,367,800	187	8,046,900	112	2,041,900	22	5,999,100	156	3,523,400	114	2,888,200	100	2,317,400	113
March,		. 101,347,800	167	6,320,400	88	1,893,200	84	4,400,700	116	2,750,600	8	2,862,000	88	2,169,400	106
April,		92,340,300	152	6,295,900	87	1,857,400	41	3,583,100	88	2,418,500	20	2,747,200	3	2,079,900	101
May,		. 92,031,500	151	6,376,400	88	1,807,100	46	3,362,300	84	2,368,400	92	2,867,100	88	2,142,100	<u>8</u>
June,		. 92,655,300	152	6,756,200	88	2,046,100	21	3,390,600	28	2,495,400	86	3,140,600	107	2,283,200	===
July,	•	. 94,162,000	154	6,751,600	88	2,063,000	252	3,451,300	86	2,500,800	86	3,380,800	115	2,322,300	. 112
August,		. 95,412,000	156	6,643,900	81	2,038,800	51	3,379,300	84	2,588,500	88	3,606,700	122	2,414,200	116
September, .		92,919,800	151	6,268,600	88	1,782,000	34	3,304,400	8	2,448,100	78	3,160,900	107	2,120,400	102
October,		. 98,548,000	152	6,207,600	38	1,642,900	4	3,197,300	38	2,304,900	22	3,055,900	108	2,069,400	8
November, .		91,141,800	148	5,857,700	<b>8</b>	1,620,800	\$	3,069,100	79	2,142,000	88	2,767,300	88	2,009,700	88
December, .		. 93,721,000	152	6,016,800	88	1,618,000	40	3,196,500	88	2,238,200	11	2,704,200	16	2,000,200	<b>3</b> 2
For the year,		. 96,422,800	157	6,548,400	8.	1,857,100	1.7	3,761,000	26	2,555,000	81	2,996,900	102	2,172,700	105

TABLE No. 23. — Average Daily Consumption of Water in Cities and Towns, etc. — Continued.

City or town,					$  \overline{\cdot}$	MELROSE.	382.	REVERE.	BR.	WATERTOWE.	STOWN.	ABLINGTON.	GTON.	MILTON	PON.	WINTEROP.	TROP.
Population supplied, .	ģ.	•		.	·	14,870.	70.	14,0	14,020.1	11,6	11,930.	10,920.	.08	7,320.	.03	7,580.	30.
					<u> </u>	GALLONS.	NB.	GALLONS.	OMB.	6ALI	GALLONS.	GALLONS.	OMB.	GALLONS.	OMB.	GALLONS.	OMB.
•	Моити.	Hi.				Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,				•	<del>-</del>	1,671,800	118	1,304,100	88	678,400	28	824,900	88	811,900	<b>87</b>	828,600	115
February,	•	•	•		-	1,845,100	125	1,530,600	111	716,200	61	970,500	88	291,000	9	959,800	128
March,	•	•	•	•	-	1,726,400	111	1,243,000	8	692,000	82	780,900	#	269,800	87	843,200	113
April,	•	•	•	•	<del>-</del>	1,623,900	110	1,152,100	88	742,000	8	775,800	76	800,100	17	797,400	106
Мау,	•	•	٠		•	1,652,800	111	1,141,400	<b>78</b>	815,000	69	821,900	18	368,000	19	787,100	106
June,	•	•	•	•	•	1,794,900	121	1,307,200	3	866,600	73	1,007,700	8	408,500	92	961,700	126
July,	•		•		•	1,817,500	122	1,437,700	103	956,600	88	1,275,000	125	420,900	57	1,127,100	149
August,	•	•	•	•	•	1,934,200	181	1,504,500	107	956,900	8	1,520,000	149	448,200	19	1,162,100	163
September, .	•	•		•	·	1,743,700	117	1,268,500	8	872,900	ြ	1,009,000	88	868,000	87	904,600	119
October,	•	•	•		•	1,726,800	116	1,065,500	15	860,500	72	861,300	<b>3</b> 5	818,000	43	794,800	104
November, .	•	•	•	•	•	1,692,800	118	997,300	2	737,400	19	724,100	20	298,500	9	781,200	8
December,	•	•	•		•	1,782,600	116	978,700	88	660,800	92	718,800	70	282,700	330	697,400	91
For the year,	•	•	•	•	•	1,748,000	118	1,240,700	88	796,800	67	839,800	83	339,800	46	863,400	117

<sup>1</sup> Includes 270 people in Saugus.

TABLE No. 23. — Average Daily Consumption of Water in Cities and Towns, etc. — Concluded.

City or town, .	٠			Brow	Втоивали.	Вигл	Вигмоит.	Гахінетон.	eron.	NAHANT.	TH.	SWAMPSCOTT.	BCOTT.	Metropolitan District.	LITAN IOT.
Population supplied,	.		.	6,	6,510.	4,5	4,560.	4,4	4,480.	1,850.	20.	6,480	.02	934,730	30.
;				BAL	GALLONS.	GALLONS	OMS.	GALLONS.	OMB.	GALLONS.	OMB.	GALLONS.	OMS.	GALLONS.	ж.
Моитн	E.			Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.	Per Day.	Per Capita.
January,				. 483,000	75	237,500	23	292,500	88	80,800	86	848,700	25	184,725,400	146
February,			•	. 576,100	88	280,400	80	813,500	Ęž.	87,100	35	883,200	20	146,118,200	158
March,				. 581,600	8	262,200	8.	817,600	73	72,100	78	358,800	99	128,891,700	139
April,	•			. 542,800	<b>3</b> 5	280,500	22	307,300	20	88,300	8	361,700	8	118,269,200	128
Мау,		•	•	. 587,200	88	\$18,300	70	318,200	원	119,400	25	423,200	8	118,247,400	121
June,				. 571,200	88	427,100	35	359,900	88	178,500	28	266,900	92	121,202,600	130
July,				. 683,600	6	498,600	108	875,690	<b>38</b>	272,200	62	770,200	88	124,211,800	133
August,				. 712,300	109	671,900	125	467,100	105	300,300	150	894,300	112	126,575,200	135
September,				. 665,100	102	355,400	77	339,500	76	174,600	8	548,200	73	120,283,700	128
October,				. 656,500	901	264,600	88	290,400	. 33	96,900	23	396,600	19	119,837,900	121
November,		•		. 652,300	100	259,700	98	278,000	25	84,400	91	821,600	28	115,885,700	123
December,	•			. 668,300	102	261,300	29	229,900	15	78,500	35	834,000	99	118,142,900	128
For the year, .	•			906,900	85	831,100	73	324,000	8/2	135,400	22	475.800	72	124,135,100	22

Table No. 24. — (Pump Basis.) Consumption of Water in the Metropolitan Water District, as constituted in the Year 1907, the Town of Swampscott and a Small Section of the Town of Saugus, from 1893 to 1907.

[Gallons per day.]

Month.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
January, .	75,209,000	67,506,000	68,925,000	82,946,000	85,366,000	83,880,000	96,442,000	100,055,00
February,	71,900,000	68,944,000	80,375,000	87,021,000	83,967,000	87,475,000	103,454,000	98,945,00
March, .	67,638,000	62,710,000	69,543,000	86,111,000	82,751,000	85,468,000	90,200,000	97,753,00
April,	62,309,000	57,715,000	62,909,000	77,529,000	79,914,000	76,574,000	86,491,000	89,497,00
Мау,	61,025,000	60,676,000	65,194,000	73,402,000	76,772,000	76,677,000	89,448,000	87,780,00
June, .	63,374,000	68,329,000	69,905,000	77,639,000	77,952,000	83,463,000	97,691,000	98,581,00
July,	69,343,000	73,642,000	69,667,000	80,000,000	85,525,000	88,228,000	96,821,000	107,786,00
August, .	66,983,000	67,995,000	72,233,000	78,537,000	84,108,000	87,558,000	92,072,000	102,717,00
September,	64,654,000	67,137,000	73,724,000	74,160,000	84,296,000	88,296,000	91,478,000	103,612,00
October, .	63,770,000	62,735,000	67,028,000	71,762,000	79,551,000	81,770,000	89,580,000	98,358,00
November,	61,204,000	62,231,000	64,881,000	71,933,000	72,762,000	78,177,000	86,719,000	93,648,00
December,	66,700,000	65,108,000	70,443,000	79,449,000	76,594,000	86,355,000	85,840,000	97,844,00
Average,	66,165,000	65,382,000	69,499,000	78,360,000	80,793,000	83,651,000	92,111,000	98,059,00
Population,	723,153	743,354	763,557	786,385	809,213	832,042	854,870	877,69
Per capita,	91.5	88.0	91.0	99.7	99.8	100.5	107.8	111.7

· Month.	•	1901.	1902.	1903.	1904.	1905.	1906.	1907.
January, .		111,275,000	118,435,000	125,176,000	137,771,000	130,878,000	126,098,000	137,730,000
February, .		117,497,000	117,268,000	122,728,000	143,222,000	140,595,000	130,766,000	150,822,000
March, .		105,509,000	108,461,000	111,977,000	123,334,000	120,879,000	123,570,000	134,202,000
April,		93,317,000	103,153,000	107,179,000	108,688,000	111,898,000	118,428,000	121,556,000
May,		95,567,000	106,692,000	111,589,000	111,715,000	115,804,000	122,404,000	123,502,000
June,		103,420,000	110,002,000	105,590,000	111,209,000	117,441,000	121,882,000	125,623,000
July,		106,905,000	108,340,000	107,562,000	113,584,000	124,769,000	118,726,000	128,779,000
August, .		102,815,000	107,045,000	103,570,000	112,836,000	121,158,000	120,591,000	131,098,000
September,		102,103,000	107,752,000	106,772,000	114,188,000	120,103,000	121,685,000	124,751,000
October.		103,389,000	106,560,000	103,602,000	108,290,000	118,301,000	116,561,000	124,051,000
November,		101,324,000	105,175,000	103,477,000	108,054,000	116,693,000	113,746,000	119,627,00
December, .		113,268,000	125,434,000	114,721,000	125,119,000	122,696,000	130,995,000	122,407,00
Average,		104,645,000	110,845,000	110,277,000	118,114,000	121,671,000	122,085,000	128,561,00
Population,		892,740	907,780	922,820	937,860	953,556	965,990	986,68
Per capita,		117.2	121.6	119.5	125.9	127.6	126.4	130.3

This table includes the water consumed in the cities and towns enumerated in Table No. 19, together with the water consumed in Newton and Hyde Park, which are included in the Metropolitan Water District, but have not been supplied from the Metropolitan Works. The populations for the years 1901 to 1904 were revised after the census of 1905 became available, and consequently the figures in the reports after 1904 differ from those published in a corresponding table in the preceding annual reports.

Table No. 25. — Chemical Examinations of Water from the Wachusett Reservoir, Clinton. [Parts per 100,000.]

нагольтан.			8	}	8.0	0.8	0.8	0.8	9.8	9.6	9.0	0.5	9.0	0.5
Oxygen Consumed.			š	}	×	.43	55	.82	38.	83	18.	83.	83	8
NITROGEN AS	Witrites.		2000		900.	2000.	1000	0000	1000	2000	.0002	.000	.0002	1000:
Nrr	Nitrates.		0000		989	990	0400	999	.0060	9900	.0030	.0030	.0080	.0010
Chlorine.			76	1	77.	.26	8.	2.	-38	33.	83	87	.21	83.
	ē.	.bebnaqang	.0084		.0022	.0048	9000	9100.	.0028	.0014	.0082	<b>.0004</b>	.0012	.0070
Анжонта.	ALBUMDRODD.	Dissolved.	.0120		9800.	9\$10.	.0110	9600.	0110	9500.	.0100	.0078	₹000	.0092
	77	.fatoT	7910		.0120	.0194	.0118	.0112	.0138	.0112	.0132	.0082	.0106	.0162
	Free.		7800	1	.0082	980	.0028	<b>7</b> 100.	.0018	.0010	-0014	.0022	.0030	.001
ENAPORA- TION.	Loss on Ignition.		1.00	3	1.40	1.16	1.06	1.00	1.00	1.10	1.20	1.85	1.46	1.15
RESIDUE EVAPOR. TION.		Total.	3.10	-	3.30	3.35	8.70	3.15	3.20	2.56	3.35	3.20	3.40	2.45
Opor.		Hot.	Distinctly vegetable	and cucumber.	Distinctly vegetable	and unpleasant. Decidedly vegetable and cucumber,	synura. Faintly vegetable.	Faintly vegetable and	unpleasant. Faintly vegetable.	Faintly vegetable.	Faintly vegetable and	unpleasant. Faintly unpleasant.	Distinctly vegetable.	Distinctly vegetable and sweetish.
Аграаванов.		Cold.	Faintly vegetable and	cucumber.	Faintly vegetable and	Distinctly vegetable and cucumber,	y. faintly vegetable.	Faintly vegetable and	unpleasant. V. faintly vegetable.	Faintly vegetable.	V. faintly vegetable	V. faintly unpleasant.	Faintly vegetable.	Faintly vegetable and sweetish.
	COLOR.	Platinum brandard.	86	•	8	12	8	61	12	8	11	61	83	19
	Sediment.		Slight	also scum.	V. slight.	Slight.	V. slight.	V. slight.	V. slight.	V. slight.	Slight.	V. slight.	V. slight.	Slight,
4		Turbidity.	V. alight. Silght.	0	None.	V. slight.	V. slight.	V. slight.	Slight.	V. slight.	V. slight.	V. slight.	V. slight.	2 V. slight.
Date of Collection.			1907.		Feb. 6	March 5	March 19	April 2	April 16	May 7	May 21	June 3	June 18	July 2
Number.			64483		64823	65254	65362	63615	65654	62808	66097	86293	66450	19999

66965	July	83	V. slight.	66965   July 23   V. slight.   V. slight.	15	V. faintly vegetable   Faintly vegetable and    2.45   1.30   .0020  .0154  .0030  .0064   .28   .0010  .0000   .29   1.1	Faintly vegetable and	2.45	1.30	.0020	.0154	0600	1900	<u>÷</u>	0010	0000	83.	1.1
67256	Aug.	8	Aug. 6 Slight.	Slight.	11	Distinctly vegetable.	table	4.10	4.10 1.50 .0030 .0206 .0146 .0060 .31 .0010 .0002	.0030	90-0	.0146	0900	<u>ن</u>	0000	2000	.33	9.0
67521	Aug.	8	67521 Aug. 20 V. slight. Slight.	Slight.	15	V. faintly vegetable.	Faintly vegetable.	2.50	1.25	9000	1.25 .0008 .0116 .0084 .0082 .27 .0010 .0000	1900.	2800.	<u>~</u>	00100	9000	25.	8.0
67795		4	Sept. 4 V. slight, V. slight.	V. slight.	Ξ	Faintly vegetable.	Distinctly vegetable.	2.30	1.35	.0028	1.35 .0028 .0114 .0100 .0014 .29 .0000 .0000	.0100	-0014	8	0000	0000	8	9.0
67940		17	Sept. 17 V. slight. V. slight.	V. slight.	13	Faintly unpleasant.	Faintly unpleasant.	3.10		9000	1.15 .0008 .0154 .0114 .0040 .25 .0010 .0000	1110.	0400	.35 .5	0100		83	9.0
68243	Oct.	-	Oct. 1 V. slight. Slight.	Slight.	13	V. faintly unpleasant. Faintly unpleasant.	Faintly unpleasant.	2.70		.0012	0.55 .0012 .0114 .0088 .0028 .28 .0010 .0001	.0088	9700.	97.	0100		72.	9.0
18481	Oct.	15	V. slight.	Oct. 15 V. slight. V. slight.	11	V. faintly unpleasant. Faintly unpleasant.	Faintly unpleasant.	2.90	2.90 1.20 0.014 0.004 0.0082 0.012 28 0.0030 0.0000	100.	₹600.	7800.	.0012	87.	0030	000	s;	9.0
68786	Nov.	20	V. slight.	Nov. 5 V. slight, V. slight.	15	Faintly unpleasant.	Distinctly unpleasant. 8.55 1.05 0.000 0.0096 0.0084 0.012 28 0.0020 0.0000	3.55	1.05	0000	9600.	.008	2100.	8.	00.00		%	9.0
28069	Nov.	10	Nov. 19 V. slight, V. slight.	V. slight.	16	Faintly unpleasant	Faintly unpleasant Distinctly unpleasant 3.45 1.35 .0012 .0102 .0092 .0010 .30 .0040 .0001	3.45	1.35	.0012	.0102	2600.	.0010	8	0700	1000	98:	1.0
69350	Dec.	83	V. slight.	69350 Dec. 8 V. slight, V. slight.	11	V. faintly vegetable.	Faintly vegetable.	2.65	1.05	.0014	1.05 .0014 .0088 .0078 .0010 .23 .0020 .0002	8700.	0000	क्ष	00500	2000	.27	9.0
69578	Dec.	17	69578 Dec. 17 V. slight. Slight.	Slight.	18	Faintly unpleasant.	Distinctly unpleasant.	3.25	1.85 .0012 .0096 .0084 .0012 .21 .0020 .0001	.0012	9600.	4900.	.0012	.21	0050	1000	æ	9.0
Av.			Αν.		18	8.10         3.10         6.001         6.000         6		3.10	1.20	.0019	9710.	6600	9700.	8	0020	1000	œ.	0.7

Table No. 26. — Chemical Examinations of Water from Sudbury Reservoir.

[Parts per 100,000.]

		Hardness.	9.0	1:1	1:1	1.0	1:1	1.3	1:0	9.8	8.0	0.8	1.3	1.8	1.0
.bed.	arns:	Охувев Соп	×.	.87		8.	8.	.e.	8.	8	.25	25.	88	8.	8. 
Niteogen As		Witrites.	.000	.000	.000	.000	.000	.000	.000	1000	900	900	.0002	1000	.000
NIT		Nitrates.	.0070	.0110	0600.	.0050	.0070	.0050	9000	0100.	.0010	.0010	.0080	.0030	.0046
		Chlorine.	ક્ષ	88	8	ĸ	8.	25	ध	ક્ર	8	덣	क्ष	2	.27
	om.	Suspended.	.0038	9000	.0028	.0012	.0024	.0028	.0028	.0010	9100.	-0014	.0028	.0012	.0021
Ажионта.	ALBUMINOID	.bevlosaiG	.0146	.0128	0110	.0116	.0118	0600.	.0118	0100	900.	9800	9010	.0114	1110.
γх	IY	.latoT	.0184	.0136	.0138	.0128	.0142	.0118	.0146	.0110	.0114	.0100	.0134	.0126	.0181
		. <del>00</del> 1¶	.0050	.0048	.0082	.0028	9100.	2400	.001	.001	.0032	9700.	.0020	.0024	.0083
RESIDUE ON EVAPORA-	.mo	no aso.I itingI	1.20	1.60	1.05	1.25	1.55	1.00	1.40	3.02	1.05	0.60	1.10	1.65	1.29
RESID EVA.		LatoT.	3.85	3.80	3.35	3.35	3.63	3.05	3.60	4.10	3.45	2.55	3.15	3.45	8.46
Оров.		Hot.	Distinctly vegetable	and unpleasant. Distinctly unpleasant,	cucumber odor. Distinctly cucumber,	synura. Faintly vegetable.	Distinctly vegetable.	Faintly vegetable.	Distinctly vegetable.	Distinctly unpleasant.	Faintly vegetable and	unpleasant. Faintly unpleasant.	Distinctly unpleasant,	nsny. Faintly unpleasant.	
OD		Cold.	Faintly vegetable and	unpleasant. Faintly unpleasant,	cucumber odor. Faintly cucumber,	synura. V. faintly vegetable.	Faintly vegetable.	Faintly vegetable.	Faintly vegetable.	Faintly unpleasant.	Faintly vegetable and	unpiessant. V. faintly unpleasant.	Faintly unpleasant.	V. faintly unpleasant.	
	COLOR.	munital¶ brabnatd.	28	53	123	ន	27	81	61	13	92	=	22	12	8
Appeabance.		Sediment.	V. slight.	V. slight.	V. slight.	Silght.	Slight.	Slight.	Cons.	V. slight.	Slight.	V. slight.	V. slight.	Slight.	
- <b>Ψ</b>		.Turbidity.	Slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	None.	V. slight.	V. slight.	None.	V. slight.	
·uo	ottoe	Date of Coll	<b>1907.</b> Jan. 15	Feb. 4	March 4	April 1	May 6	June 3	July 2	Aug. 5	Sept. 3	Oct. 1	Nov. 4	Dec. 4	
		Ултрет.	64467	64753	65196	65485	82889	66267	89999	67223	67738	68233	99129	69863	Av.

Table No. 27. — Chemical Examinations of Water from Spot Pond, Stoneham.

[Parts per 100,000]

		наепрлен.	1.8	1.4	1.4	1.3	1.1	1.0	1.3	1.0	1.8	1:4	1.1	1.6	1.3
.bed.	uns	Охувев Соп	83.	ક્ર	\$	ž.	25.	.24	98.	35	25.	83	-52	25.	98.
Nitrogrn Ab		Nitrites.	9000	0000	7000	9000	1000	1000	.000	9000	1000	0000	9000	1000	1000
NITI		Nitrates.	0800	.0040	.0060	.0050	040	.0020	.0010	0100	.0010	.0020	.0010	.0020	.0025
		Съдотіве.	.34	.38	87.	8.	8.	83	83	85	₹.	8	8	98.	.32
	D.	Suspended.	.0014	00100	.0010	.0014	.0020	.0022	.0018	.0028	.0084	.0022	.0020	.0010	6100.
ONTA.	ALBUMINOID.	.bevlossid	.0142	.0126	.0102	0110	0110	8600.	.0122	.0124	.0126	.0132	.0100	.0118	.0118
Аммоита.	AE.	.latoT	.0156	.0136	.0112	.0124	.0130	0210.	.0140	.0152	.0160	.0154	.0120	.0128	.0186
		Free.	.0042	.0088	.0038	.0026	₹000	.0022	2000	₹000	.0014	00.00	9100.	2100.	.00%
RESIDUE ON EVAPORA- TION.	·uo	Loss on Igniti	1.00	1.60	1.15	1.10	1.25	1.40	1.15	1.25	1.00	1.00	1.00	1.50	1.20
REGIDUE EVAPOI TION		.latoT	2.75	4.35	3.25	3.10	3.40	3.10	2.85	3.35	3.82	2.85	3.45	3.85	3.27
Оров.		Hot.	Faintly vegetable and	unpressant. Distinctly unpleasant.	Faintly vegetable.	Faintly vegetable.	Distinctly unpleasant,	Faintly vegetable.	Faintly vegetable.	Faintly vegetable.	Distinctly vegetable.	Faintly vegetable.	Faintly vegetable.	Faintly vegetable.	
<b>a</b> 0		Cold.	V. faintly vegetable	Faintly unpleasant.	V. faintly vegetable.	Faintly vegetable.	Faintly unpleasant,	V. faintly vegetable.	Faintly vegetable.	Faintly vegetable.	Distinctly vegetable.	V. faintly vegetable.	None.	V. faintly vegetable.	
-	COLOR.	Platinum Standard.	11	92	16	15	12	13	=	Ħ	92	13	12	22	22
Appearance.		Sediment.	ight. V. slight.	V. slight.	V. slight.	Slight.	Slight.	Slight.	V. slight.	Slight,	Sligi	Slight.	V. slight.	Slight.	
₽.		Turbidity.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	V. slight.	
·uo	itoe.	Date of Coll	1907. Jan. 17	Feb. 4	March 4	April 1	May 6	June 3	July 1	Aug. 5	Sept. 3	Oct. 7	Nov. 11	Dec. 9	
		лефти Д	64497	64779	62173	66483	65877	66243	66617	61219	67741	88303	68867	₹0 <del>7</del> 69	Αν

.42 2.2 .42 2.1 .42 2.1 .36 2.0

2.1

8 8 4 4 8 8 9

Table No. 28. — Chemical Examinations of Water from Lake Cochituate.
[Parts per 100,000.]

						rarts per 100,000.				١					ı
	·uo	¥	APPEABANCE.		00	Оров.	RESIDUE ON EVAPORA- TION.	EVAPORA- TION.		Ажкойта.	MIA.			Nitrogra As	<b>6EM</b>
	itoel			COLOR.				·uo		ALB	ALBUMINOID.	Ġ.			
Number.	IloD to etse	Tarbidity.	.tuemipe8	Platinum Standard.	Cold.	Hot.	.latoT	no ano.I itingl	.eerH	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.
64449	1907. Jan. 15	Slight.	Slight.	7.2	Faintly vegetable,	A	5.10	3.85	.0088	.0230	.0180	.0040	4.	0800	.0001
64777	Feb. 4	V. slight.	V. slight.	333	Cucumber. Distinctly unpleasant and musty. Cucum.	Cucumber. Distinctly unpleasant and musty. Cucum-	5.70	23.	1400.	8710.	.0156	2700:	84.	0700	.000
66188	March 4		V. slight. V. slight.	88	ber, synura. V. faintly unpleasant.	ber, synura. Faintly unpleasant.	6.10	2.00	9100.	.0168	.0158	00100	74.	9900	.000
65496	April 1	V. slight.	V. slight.	27	Distinctly musty, de-	Ω	5.40	2.02	<b>7</b> 100.	.0192	.0170	.0022	14.	0600	1000
65885	May 6	Silght.	Slight.	æ	Distinctly unpleasant	А	4.80	2.35	8900	9610.	.0160	9890	8	0700	2000
66246	June 8	V. slight.	Cons.	88	Faintly vegetable	and musty. Distinctly vegetable	4.80	1.95	7700.	.0362	.0194	.0168	<b>3</b>	0000	.000
66628	July 1	Slight.	Slight.	23	and musty. Faintly unpleasant.	and musty. Distinctly unpleasant.	4.85	1.25	.0082	.0828	.0228	0100	3	00100	1000
67228	Aug. 4	V. slight.	Slight.	21	Faintly unpleasant	Faintly unpleasant	2.00	2.10	2100.	9610	.0168	.0028	.57	0100	2000
67738	Sept. 8	V. slight.	Slight.	19	Faintly vegetable and unpleasant.	Distinctly vegetable and faintly unpleas-	2.00	1.85	7200:	.0278	.0192	9900.	8	00100	9000
68216	Oct. 1	V. slight.	Slight.	18	Faintly vegetable and	ant. Faintly vegetable and	4.80	1.70	<b>7</b> 100.	9220	.0168	9900.	<b>z</b> i	0100	900.
68747	Nov. 4	V. slight.	Cons.	22	Faintly vegetable and	1	5.95	8.8	.0062	.0224	.0178	9700.	12	0100	1000
69410	Dec. 9	Slight.	Slight.	88	Faintly vegetable.	Distinctly vegetable.	2.50	1.80	.0012	.0280	.0162	9900	ĸ	0000	.000
Αν	Αν			22			5.25	1.94	.0082	.0238	.0176	.0067	35	0000	.0001
			i												

Table No. 29. — Chemical Examinations of Water from a Tap at the State House, Boston. [Parts per 100,000.]

Part   Part		• च		APPEABANCE.		0008	08.	RESIDUE ON EVAPORA-	EVAPORA- TION.		Ажиоміа.	MIA.			Niteogra As	Na e	.6d.	
1997.   1997.   1996		oitoe			COLOR.				·uo		ALB	UMINO	ف ا	!			ume	
Handle   Falight   Falig	Number.	Date of Coll	Torbidity.	Sediment.	Platinum Standard.	Cold.	Hot.	Total.	no sao.I ltingI	.ee.T	LatoL.	.bevlossid	.bebnagard		.aotartiN	Nitrites.		Hardness.
Rach 4         V. slight.         V. slight.         22         Faintly vegetable.         Distinctly vegetable.         4.00         1.50         .0046         .0106         .0096         .009         <		1907. Jan. 14	8.	. Slight.	19	Faintly vegetable.	Faintly vegetable.	3.10		.0022	0122							=
March 4         Slight.         None.         23         V. faintly unpleasant.         Faintly unpleasant.         Faintly vegetable.         Distinctly vegetable.         Faintly vegeta	64748	Feb. 4	I V. slight		83	Faintly vegetable.	Distinctly vegetable.	4.00	1.50				-					::
April 1         V. slight, V. slight, Slight,	65170	March 4	Sligh	None.	ន	V. faintly unpleasant.	Faintly unpleasant.	<b>6.</b> %	1.25					_		<u> </u>		æ:
May         6         V. slight.         31ight.         119         Faintly vegetable.         Faintly vegetable.         Faintly vegetable.         3.20         1.40         0.006         0.012         0.006         0.012         0.006         0.012         0.006         0.01         0.00		April 1			22	Distinctly vegetable.	Distinctly vegetable.	8.95	1.20									8:
June         8         Slight.         Y. alight.         26         Faintly vegetable.         Distinctly vegetable.         Distinctly vegetable.         B.55         1.55         1.00         0.008         0.046         0.008         0.046         0.009         0.000         0.00			₹.8	. Slight.	19	Faintly vegetable.	Faintly vegetable.	3.30	1.40							_		Ξ
July 1         V. slight. Cons.         26         Distinctly vegetable, fanity unpleasant.         Joint Land Land Land Land Land Land Land Land			Sligh	V. alight.	88	Faintly vegetable.	Distinctly vegetable.	3.30	1.00							_		<b>*</b> :
Aug. 5         V. slight.         V. slight.         22         Faintly unpeasant. and earthy.         Paintly vegetable and and earthy.         Paintly vegetable and and earthy.         Paintly vegetable and and earthy.         Paintly vegetable and and earthy.         Paintly vegetable and and earthy.         Paintly vegetable and and earthy.         Paintly vegetable.         Paintly vegetable. <th></th> <th></th> <th>₩.8</th> <th>Cons.</th> <th>56</th> <th>Distinctly vegetable,</th> <th></th> <th>3.55</th> <th>1.35</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>9:</th>			₩.8	Cons.	56	Distinctly vegetable,		3.55	1.35									9:
Sept. 3         V. slight.         V. slight.         26         V. faintly unpleasant.         Faintly unpleasant.         Faintly unpleasant.         Faintly unpleasant.         Faintly unpleasant.         Faintly vegetable.         Faintl	67209		V. 81		ĸ	Faintly vegetable and	3	4.15	1.65									6:1
Oct. 1         V. slight, V. slight, V. slight, V. slight, Dec. 3         Total state of the s			V. sl		56	V. faintly unpleasant.	Faintly unpleasant.	8.4										×:
Nov. 4         V. slight.         V. slight.         15         Faintly vegetable and sweetlah.         Distinctly vegetable and sweetlah.         4.15         1.65         0.0014         0.014         0.013         0.002         1.00         1.00         0.001         1.00		Oct. 1	l V. slight		83	V. faintly vegetable.	Faintly vegetable.	4.15	1.40				_					
Dec. 8         V. slight.         T. slight.         19         Faintly earthy.         Faintly earthy.         Faintly earthy.         Faintly earthy.         4.15         1.65         0.002         .0132         .0109         .000         .88         .0060         .0001         .38           23         .000		Nov. 4	V. slight		18	Faintly vegetable and	•	3.65	1.80									1.7
3.85   1.40   .0013   .0129   .0109		_	V. 81	>	19	Faintly earthy.	Faintly earthy.	4.15	1.65				_					1.7
	Av.		•					3.83										æ:

натепева.

Table No. 30. — Averages of Examinations of Water from Various Parts of the Metropolitan Water Works in 1907.

Oxygen Consumed 8 Mitrites. NITROGEN Nitrates. Орјогіве. -eng ALBUMINOID 00077 00078 00078 00077 00078 00078 00078 00078 Dia-solved. Ажмонта. 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 0.01288 Total. 81500 81000 81000 81000 81000 81000 81000 81000 81000 81000 81000 Free. [Parts per 100,000.] - 88888888888418458 RESIDUE ON EVAPORATION. Loss on .[atoT COLOR. Btandard. \$4\$85898985818<u>8</u>288585868448848188 Platinum Semi-monthly, Semi-monthly, Semi-monthly, Semi-monthly, Samples Collected. Monthly,
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Mon Monthly, Monthly, Monthly, Quinepoxet River, Holden, Still water River, Stearling, Wachusett Reservoir, Clinton, surface, Wachusett Reservoir, Clinton, surface, Wachusett Reservoir, Clinton, surface, Marthorough (Walker's Brook), Marthorough Strook filter-beds, effluent, Wachusett, Aqueduct, Southborough, Framingham Reservoir, No. 3, iniet, Framingham Reservoir, No. 3, near dam, Hopkinton Reservoir, iniet, Hopkinton Reservoir, surface, Hopkinton Reservoir, bottom, Ashitand Reservoir, iniet, Dear (an Ashland Reservoir, surface,
Ashland Reservoir, bottom,
Framingham Reservoir No. 2, inlet,
Framingham Reservoir No. 2, pear. Jake Cochinate, surface,
Lake Cochinate, bottom,
Dug Pond,
Weston Reservoir,
Terminal chamber, Sudbury A Sudbury Reservoir, surface, Sudbury Reservoir, bottom, LOCALITY. Spot Pond, Tap in Revere, Tap at State House, Tap in Quincy,

Table No. 31. — Chemical Examinations of Water from a Faucet in Boston, from 1892 to 1907.

[Parts per 100,000.]

		Cor	LOR.		UE ON RATION.		Амм	ONIA.			NITRO	GEN AS	med.	
YEAR.		ard.	ard.		ion.		AI	BUMINO					onsu	١.
1244		Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	Total.	Dis- solved.	Sug- pended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
1892, .		.37	37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
1893, .		.61	53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.60	1.8
1894, .		.69	58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
1895, .		.72	59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
1896, .		.49	45	4.29	1.67	.0005	.0165	.0142	.0023	.87	.0155	.0001	.56	1.4
1897, .	•	.65	55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
1898, .		.41	40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
1899, .	•	.23	28	8.70	1.30	.0606	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1
1900, .	•	.24	29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3
1901, .	•	.24	29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0178	.0001	.42	1.7
1902, .		.26	30	3.93	1.56	.0016	.0139	.0119	.0020	.29	.0092	.0000	.40	1.3
1903, .		.25	29	3.98	1.50	.0013	.0125	.0110	.0015	:30	.0142	.0001	.89	1.5
1904, .		-	23	3.93	1.59	.0023	.0139	.0121	.0018	.34	.0110	.0001	.37	1.5
1905, .	•	-	24	8.86	1.59	.0020	.0145	.0124	.0021	.35	.0083	.0001	.35	1.4
1906, .	•	-	24	<b>3.86</b>	1.89	.0018	.0159	.0184	.0025	.34	.0054	.0001	.36	1.3
1907, .		-	22	3.83	1.40	.0013	.0129	.0109	.0020	.33	.0068	.0001	.32	1.3

Note relating to Chemical Examinations of Water, Tables Nos. 25-31.

The chemical examinations contained in the tables were made by the State Board of Health. Previous to the year 1904 colors were determined by the Nessler standard, but the corresponding values by the platinum standard are also given, for the purpose of comparison with colors determined in the laboratory of the Metropolitan Water and Sewerage Board, as given in subsequent tables. The odor recorded is taken in such a way that it is a much stronger odor than would be noticed in samples drawn directly from a tap or collected directly from a reservoir. The important samples are collected and examined semimonthly or monthly.

Table No. 32. — Colors of Water from Various Parts of the Metropolitan Water Works in 1907. (Means of Weekly Determinations.)

[Platinum Standard.]

	W	7 дсн	USEI	т Re				Sud Rese	BURY		Framingham Reservoir No. 3.	LAN	æ Co	СНІТІ	JATE.
Монтн.	Surface.	Mid-depth.	Bottom.	Worcester Street Bridge.	Quinepoxet River.	Stillwater River.	Burface.	Mid-depth.	Bottom.	End of Open Channel.	Mid-depth.	Surface.	Mid-depth.	Bottom.	Influent Streams. <sup>1</sup>
January, . February, . March, . April, . May, . June, . July, . August, . September, . October, . November, . December, .	19 25 27 23 26 24 28 23 19 15 17 24	19 23 25 23 24 24 22 23 19 15 17 25	19 22 25 23 24 24 22 23 20 16 17 25	86 33 89 87 42 43 40 28 22 33 40 46	44 40 45 42 58 58 59 44 49 67 68 49	39 33 35 35 50 51 52 38 42 58 61 41	22 27 25 23 24 23 21 22 18 15 17 26	21 25 25 23 24 23 21 22 19 15 17 26	21 25 25 24 24 23 22 22 19 16 18 26	29 24 34 34 31 32 24 24 24 24 59 50	20 24 25 24 25 24 25 24 23 22 19 17 23 29	29 38 38 30 34 35 28 29 26 23 27 28	28 31 29 31 29 31 28 31 26 27 28	29 65 70 32 29 47 66 55 44 144 28 28	48 58 69 83 103 108 91 77 81 77 88 90

<sup>&</sup>lt;sup>1</sup> The colors given in this column represent the combined colors of the waters of the four principal feeders. The color of each is determined monthly, and due weight is given, in combining the results, to the sizes of the streams.

TABLE No. 32 — Concluded.
[Platinum Standard.]

		STNUT E		SPOT POND.	FELLS RESERVOIR.		THERN RVICE.	11	HERN VICE.
Month.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate- house No. 2.	Mid-depth.	Effuent Gate-house.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 244 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January, February, March, April, May, June, July, August, September, October, November, December, .	. 20 . 24 . 25 . 23 . 26 . 34 . 33 . 39 . 39 . 28 . 21 . 28	- 82 33 27 - 28 27 28 26 26 22 29	19 24 25 23 25 31 30 33 32 27 21	16 16 18 17 17 17 18 20 17 17 16	16 16 18 18 17 17 18 20 17 17	20 24 26 23 24 29 30 32 32 23 19 25	16 16 18 17 17 17 18 20 18 15 16	19 24 25 23 24 27 28 81 28 22 18	20 24 26 23 25 32 81 82 82 26 22
Mean,	. 28	28	26	17	17	26	17	25	27

Table No. 33. — Temperatures of Water from Various Parts of the Metropolitan Water Works in 1907. (Means of Weekly Determinations.)

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth given for each reservoir is the depth from high-water mark.]

[Degrees Fahrenheit.]

		ACHUSE SERVO		(DE	BURY DEBURY DESCRIPTION OF THE PROPERTY OF THE	PLACE VATION	OF	VOIR I	GHAM I No. 3 (I CE OF ( 1 20.5 F	BSER-	OF O	COCHI TH AT I BSERVA O FEE	PLACE
Монтн.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.
January, February, March, April, May, June, June, August, September, October, November, December,	33.0 33.2 34.5 41.9 51.7 64.5 71.9 75.0 65.8 56.6 47.0 38.5	34.2 36.2 40.9 49.5 53.8 55.8 62.8 62.5 56.2 47.3 38.6	35.3 35.2 40.5 48.6 52.5 55.3 57.1 56.0 53.8 47.0 38.6	34.6 32.3 33.4 41.6 53.9 64.0 74.4 73.4 68.3 56.5 44.9 36.0	85.4 83.4 84.0 41.9 53.5 58.8 68.8 71.1 68.0 56.7 45.8 36.5	36.3 34.4 35.1 42.1 52.6 57.8 64.2 67.9 67.1 56.4 45.4	84.9 32.5 85.6 41.0 51.3 56.4 61.6 63.6 63.9 54.4 45.6 87.1	36.0 34.4 36.7 44.2 54.4 65.9 75.6 73.5 67.8 53.2 43.9 35.9	36.0 35.0 37.0 44.0 54.5 63.3 75.0 73.2 68.3 53.7 43.6 36.0	35.0 35.7 37.4 43.9 54.2 60.6 73.0 72.8 68.1 53.8 43.7 36.0	36.0 35.1 35.6 41.8 54.8 63.3 76.0 73.6 70.0 56.0 47.1 87.7	36.7 36.6 36.8 41.6 52.8 56.4 54.9 53.6 56.0 54.3 46.6 38.2	37.3 37.7 38.5 41.8 45.6 48.0 47.0 47.6 47.0 46.4 46.4 38.4
Mean, .	51.1	48.8	47.3	51.1	50.8	49.6	48.2	51.8	51.6	51.2	52.2	47.0	43.5

## TABLE No. 33 — Concluded.

#### [Degrees Fahrenheit.]

	CHESTNUT HILL RESERVOIR.	PLACE	OND (DEP OF OBSERV 3.0 FEET)	MOITAV		THERN EVICE.	SER	HERN VICE.
Month.	Effluent Gate. house No. 2.	Surface.	Mid-depth.	Bottom.	Tap at Glenwood Yard, Medford (Low Service).	Tap at Fire Station, Hancock Street, Everett (High Service).	Tap at 244 Boylston Street, Boston (Low Service).	Tap at 1 Ashburton Place, Boston (High Service).
January,	35.7 36.5 43.7 54.3 61.1 74.1 - 73.2 68.9 55.1 49.2 37.1	36.0 35.8 36.6 42.6 53.6 61.8 72.9 73.0 68.3 56.3 45.5	36.1 36.8 37.5 42.6 53.4 60.1 72.8 72.9 68.1 55.9 45.5	36.7 38.5 39.0 42.7 53.0 56.9 61.3 66.0 67.4 55.9 45.5	38.0 37.0 87.4 43.7 52.3 58.5 70.3 66.8 56.8 48.5 40.8	87.6 37.1 37.5 44.3 58.0 59.6 68.6 72.3 68.8 56.6 47.5	39.1 39.8 39.9 46.7 56.0 61.8 70.0 71.1 68.5 58.1 49.1 41.3	38.7 39.4 38.8 46.0 56.8 62.8 73.2 72.7 68.9 58.1 49.4
Mean,	52.1	51.5	51.4	49.9	51.6	51.9	53.5	53.8

Table No. 34. — Temperatures of the Air at Three Stations on the Metropolitan Water Works in 1907.

[Degrees Fahrenheit.]

				estnut E Eeservoii		Fi	AMINGHA	w.		CLINTON.	
Mont	Ħ.		Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mesn.
January,			57.0	-9.0	26.1	54.0	-17.0	23.2	55.0	-12.0	22.7
February,			51.0	-10.0	21.6	48.0	-19.0	18.5	46.0	-11.0	15.8
March, .			72.0	7.0	37.5	76.0	4.0	35.7	77.0	-5.0	33.6
April, .			74.0	21.0	44.0	75.0	19.0	41.9	69.0	20.0	41.1
Мау, .			82.0	32.0	53.7	85.0	29.0	51.4	84.0	28.0	51.3
June, .			94.0	38.0	64.7	94.0	35.0	62.5	90.0	41.0	64.1
July, .			93.0	53.0	72.6	91.0	46.0	69.6	89.0	56.0	71.4
August, .	•		99.0	45.0	70.0	96.0	40.0	66.8	92.0	44.0	67.5
September,			89.0	40.0	64.5	87.0	82.0	63.0	83.0	40.0	61.2
October, .			72.0	21.0	49.1	70.0	16.0	45.4	70.0	25.0	46.5
November,	•		61.0	21.0	41.7	61.0	15.0	39.0	60.0	18.0	38.0
December,	•		62.0	12.0	34.9	61.0	7.0	81.5	62.0	15.0	32.1
Average,			-	-	48.4	-	-	45.7	-	-	45.4

TABLE No. 35. — Table showing Length of Main Lines of Water Pipes and Connections owned and operated by Metropolitan Water

					Diam	DIAMERIE OF PIPES IN INCHES.	Press in	INCHES.						[
	3	48	43	86	30	24	98	16	14	13	.10	<b>90</b>	9	
Total length owned and operated January 1, 1907 (feet),		9,069 171,168	8,075	46,688	26,922	46,654	57,085	768,43	98	19,858	<b>814</b>	1,683	118	442,508
Gate valves in same,	ī	43	ı	<b>\$</b>	88	8	82	88	-	2	22	14	15	361
Air valves in same,	.0	305	89	28	4	19	\$	8	,	8	,	,	'	270
Length laid or relaid during 1907 (feet),	'	•	•	1	1	•	176	171	١	25	,	•	•	430
Gate valves in same,	ı	,	'	-	1	•	,	•	'	4	1	1	,	90
Air valves in same,	1	•	1	•	1	'	1	•	1	•		•	ı	•
Length abandoned during 1907 (feet),	1	•	J	1	1	ı	1	1	•	1	1	,	1	ı
Gate valves in same,	1	1	1	1	1	•	•	•	1	ı	1	1	1	•
Air valves in same,	1	ı	1	ı	•	1	1	•	,	,	1	1	'	,
Length owned and operated January 1, 1908 (feet), .		9,069 171,163	8,075	46,638	26,923	46,654	57,260	24,565	56	19,437	614	1,633	877	442,9831
Gate valves in same,	1	43	1	4	88	88	<u></u>	8	1	7.	13	2	15	367
Air valves in same,	10	102	က	8	4	19	*	8	1	6	ı	1	1	<b>3</b> 70
											-     			

1 83.89 miles.

Table No. 36. — Statement of Cast-iron Hydrant, Blow-off and Drain Pipes, owned and operated by Metropolitan Water and Sewerage Board, Dec. 31, 1907.

			Į d	DIAMETER OF PIPES IN INCHES.	грва ти Імон	186.			
	2	8	16	81	2	<b>so</b>	•	4	Total.
Total length in use December 31, 1907 (feet), Total valves in use December 31, 1907,	862	- 288	<b>2,250</b> 18	4,421	178	815 1	2,713	1,167	11,68 <b>4</b> 189

Table No. 37. — Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metrotopolism Water Works, Dec. 31, 1907.

	-									INCHES										TOTAL	4
Вт wном Оwned.	8	\$	8	9	88	8	90 et	2	2	<u>e</u>	9	1	81	9	æ	~	•	ю	4	Feet.	Miles.
Metropolitan Water 9,		069 171,163	8,075	,	46,638	28,92	ī	46,654	67,260	-	54,565	8	19,487	<b>814</b>	1,688	'	778	•	,	442,983	88.88
Works.					_													_			
Boston,	·		38,263 16,813 23,104 48,488	23,104	48,488	89,700	244	77,563	94,674	1	206,057	-	1,209,692	162,982	614,439	ı	1,291,615	•	67,702	8,985,286	745.82
Somerville, .	•	•	·	•	1	ı	ı	,	3,596	387	3,537	8,087	79,726	48,286	96,434	ī	198,649	•	20,456	468,108	86.76
Malden,	<u>'</u>	·	١		1	11	1	,	1	ı	'	9,152	64,216	27,024	78,083	1	203,639	1	68,861	440,925	88.51
Chelses,	٠ 		·	1	•	• 1	,	,	'	1	2,380	1	•	39,511	27,324	1	183,083	ī	8,448	210,746	88.88
Everett,	<u>.</u>	•	•	1	1	•	1	2,484	2,900	1	2,233	206	5,570	39,946	19,847	,	183,548	1	30,972	287,706	45.02
Quincy,	<u>.</u>	-	ı	ī	1	,	1	,	2,679	1	23,232	<u>'</u>	26,104	82,166	90,344	충	227,284	8	99,854	508,605	86.88
Medford,	<u>.</u>	'	1	ı	ı	'	ī	,	673	1	6,775	9,598	26,112	85,738	72,453	•	96,550	•	36,790	288,689	58.78
Melrose, .	<u>.</u>	•	ı	i	1	,	1	•	'	1	5,223	2,920	24,809	14,616	24,289	•	116,904	1	181,99	245,508	46.50
Revere,1	·	'	1	ı	ı	ı	-	1	'	1	22,650	5,700	11,000	17,050	17,855	1	54,382	•	71,284	189,421	87.77
Watertown, .	<u>.</u>	·	1	•	1	1	1	1	•	:	100	11,877	6,969	4,169	19,511	ı	115,879	1	12,666	170,481	32.28
Arlington, .	<u>.</u>	'	'	1	'	1	,	•	1	1	1	,	31,804	21,621	28,583	1	81,228	1	28,116	191,302	36.38
Militon,	•	' -	1	,	1	ı	ī	1	1	ı	108	44	22,487	19,047	41,491	ı	110,270	1	15,326	208,718	89.68
Winthrop, .	•		1	•	1	1	ī	1	ı	1	1	•	4,019	4,980	19,329	ı	27,828	1	181,77	183,867	25.35
Stoneham, .	•		1	1	ı	ı	1	1	1	1	1	1	4,525	4,726	2,975	ı	90,850	1	13,438	116,518	22.07
Belmont, .	<u>.</u>	· 	1	ı	ı	ı	1	ı	1	1	,	ı	2,161	12,302	13,696	1	78,610	ı	88	107,062	<b>30.38</b>
Lexington, .		' 	1	·	1	•	,	ı	1	•	,	 I	9,000	2,664	8,113	1	49,065	ı	33,874	102,706	19.42
Nahant,	•	·	1	ı	1	٠,	ı	1	1	ı	·	1	25	11,550	4,300	ı	82,740	•	87,865	86,295	16.34
Swampscott, .	<u>.</u>	1	1	'	•	•	ı	•	1	-	,	•	12,072	16,206	10,696	•	51,973	ı	9,110	100,056	18.96
Total feet,	9,0	069 209,426 24,888 23,104 90,126 116,622 244 126,701 161,782	24,888	23,104	90,126	116,622	244	126,701		387	387 326,155 4	1,560	47,560 1,558,783 515,126 1,185,245	15,126	1,185,245	99	994 8,088,964		948 683,763	8,174,897	ı
Total miles,	<del>-</del>	.72 39.66	4.71	4.38	4.38 17.07 22.090.05	22.09	0.02	<b>24</b> .00	80.64 0.07	70.	61.77	9.01	296.22	97.56	224.480.19	0.19		0.18	585.98 0.18 129.50	,	1,548.28

1 Including small portion of Saugus.

Table No. 38. — Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works, Dec. 31, 1907.

			Citi	OR	Town	τ.					Services.	Meters.	Fire Hydrants
Boston, .	•	•		•						•	93,942	5,190	8,136
Somerville,	•		•						•		11,662	3,446	1,022
Malden,			• .								7,055	6,780	414
Chelsea,			•								6,603	1,792	826
Everett, 、											5,161	116	517
Quincy, .											6,091	1,480	715
Medford,											4,378	582	518
Melrose,											3,429	1,058	297
Revere,1											2,927	163	152
Watertown,										•	1,886	1,886	335
Arlington,									•		1,929	835	376
Milton, .											· 1,285	1,285	317
Winthrop,											2,074	70	121
Stoneham,									•		1,331	30	112
Belmont,	•						•				792	792	164
Lexington,					·						780	80	107
Nahant, .			, •								410	90	73
Swampscott,											1,307	892	131
Total,								_			152,992	26,567	13,828

<sup>&</sup>lt;sup>1</sup> Includes small portion of Saugus.

Table No. 39. — Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, to which Water rose, at Different Stations on the Metropolitan Water Works in 1907.

ION.	TOWN WORKS , MAIN EFT.	.anuatiaiM	261	261	258	259	257	323	251	251	526	258	257	267	192
Southern High-service	WATERTOWN WATER WORKS OFFICE, MAIN STREET.	.mumixeM	384	797	263	263	362	261	261	383	362	2962	88	262	898
тнвви В	POLITAN WATER WORKS OFFICE, 1 ASHBURTON PLACE.	Minimum.	234	234	235	236	283	234	233	233	234	282	232	235	<b>583</b>
Bot	BOSTON METRO- POLITAN WATER WORKS OFFICE I ASHEURTON FLACE.	.mnmixaM	245	246	878	549	549	248	247	247	247	549	249	248	248
	CHELSEA WATER WORES OFFICE, PARK STREET.	.anuminiM	141	136	14.5	154	151	153	156	152	153	153	155	153	191
	CHE WATER OFFICE STE	.mumixaM	155	147	156	164	165	166	166	165	164	191	164	162	162
	MALDEN WATER WORKS SHOP, GREEN STREET.	.mvminiM	161	158	160	160	191	191	162	191	160	167	191	159	180
	MALDEN WORKS GREEN	.mumixaM	164	162	163	191	165	165	. 38	165	164	191	197	162	164
	SOMERVILLE CITY HALL ANNEX, WALNUT STREET.	.anuminiM	159	<b>15</b> 2	158	162	168	168	168	162	163	163	163	163	181
	BOMEB CITY ANNEX, STR	.mumixaM	164	191	163	169	170	169	170	169	169	169	168	168	167
Low-service.	MEDFORD, WATER WORKS OFFICE, HIGH STREET.	.mvminiM	164	191	162	162	163	164	164	163	164	164	164	165	163
Low-s	MEDI WATER OFFICE STE	.mumixaM	.167	165	165	167	168	167	167	167	166	167	167	167	167
	MEDFORD, MYSTIC RESERVOIR.	.mvminiM	165	163	164	164	164	165	165	165	164	163	163	164	164
	MEDI	.mumixeM	168	166	166	168	169	169	170	168	168	168	167	167	168
	ALLETON RNGINE HOUSE, HARVARD STREET.	.muminiM	171	175	179	174	173	174	174	175	172	171	171	178	174
	ALLA ENGINE HAB	.mumixaM	187	185	187	187	186	186	185	186	182	188	178	181	181
	TON HOUSE, FINCH	.muminiM	123	116	122	120	192	118	118	113	118	123	126	120	120
	BOSTON ENGINE HOU BULFINCH STREET.	.mumixaM	131	125	131	131	135	132	131	130	131	133	133	132	131
	1907.	MONTH	January, .	February, .	March,	April,	Мау, .	June,	July,	August, .	September, .	October, .	November, .	December, .	Averages,

TABLE No. 39. — Average Maximum and Minimum Monthly Heights, in Feet, above Boston City Base, etc. — Concluded.

H Extra	LEXINGTON TOWN HALL, MASSA- HUBETTS AVENUE.	Minimum.	2967	<b>3</b>	88	7967	8	20	098	<b>88</b>	798	798	88	886	988
Norteer Exte. High-errice.	LEXINGTON TOWN HALL, MASSA- CHUSHTYS AVENUS	.anadzaM	878	878	<b>5</b>	386	88	88	388	88	386	8	868	878	386
	WORES, WIN-	.anminiM	•	•	•	1	ı	184	146	187	169	161	161	162	168
	WINTHROP WATER WORKS OFFICE, WIN- THROP AVENUE	.anumixeM	ı	٠	ı	1	'	186	981	181	188	184	189	18	189
	INGINE UNION	.mvminiM	248	176	8	8778	376	2	201	808	281	976	麗	258	288
10E.	LYNN RNGINE HOUSE, UNION SQUARE.	.mumixaM	828	808	98	198	281	528	2	25	267	8	398	393	258
Northern High-service	REVERE WATER WORES OFFICE, BROADWAY.	.annaniniM	360	876	250	249	246	230	214	22	82	250	252	258	. 241
PTHER E	REVERS WORES BROAT	.mumixaM	262	33	198	898	88	898	322	257	828	381	78	386	281
NO.	KALDEN OITT HALL.	.muminiM	266	988	267	267	<b>88</b>	288	88	262	263	365	388	267	265
	MAI	.mumixeM	369	698	270	270	88	569	898	898	369	112	172	272	270
	SOMERVILLE PUMPING STA- TION, CEDAR STREET.	.anminiM	255	253	797	255	荔	249	742	247	251	255	792	257	258
	SOMED PUMPD TION, STR	.mvmixeM	368	<b>98</b>	267	368	<b>88</b>	287	267	267	267	388	569	289	288
eri.	WATER	.mnminiM	220	218	219	230	218	717	808	908	214	216	222	233	217
onclude	QUINCY WORES	.mumixaM	237	252	823	238	239	237	336	235	236	287	233	239	287
RVICE — (	MILTON WATER WORES OFFICE, ADAMS STREET.	.mvminiM	236	235	88	238	235	335	嚣	233	75	235	2837	237	255
Н16н-8к	MILTON WORES ADANS	.mumixaM	245	248	246	346	246	247	247	245	244	246	247	742	246
Southern High-servics — Concluded	BELMONT TOWN HALL, PLEASANT STREET.	.muminiM	254	253	250	249	246	241	237	228	250	258	251	250	247
au .	BELMON HALL, P. STR	Maximum.	259	259	380	780	281	259	258	258	280	361	356	792	259
	1907.	HONTH	January, .	February,	March, .	April, .	Мау, .	June, .	July, .	August, .	September,	October, .	November,	December,	Averages,

## APPENDIX No. 3.

WATER WORKS STATISTICS FOR THE YEAR 1907.

The Metropolitan Water Works supply the Metropolitan Water District, which includes the following cities and towns:—

			Cr	TY OR	Tov	VN.					Population, Census of 1905.	Estimated Population July 1, 1907.
Boston, .			. •	•					•	•	595,880	612,580
Somerville,		•									69,272	72,540
Malden, .	•	•				•					38,037	39,820
Chelsea, .	•										37,289	38,650
Newton,1.	٠.	•									36,827	38,310
Everett, .									•		29,111	31,350
Quincy, .											28,076	29,390
Medford, .											19,686	20,700
Hyde Park,1											14,510	14,970
Melrose, .											14,295	14,870
Revere, .											12,659	13,750
Watertown,											11,258	11,930
Arlington,											9,668	10,220
Milton, .											7,054	7,320
Winthrop,											7,034	7,580
Stoneham,											6,332	6,510
Lexington,											4,530	4,920
Belmont, .											4,360	4,560
Nahant, .											922	930
Total pop	ulati	on o	f Me	tropo	litar	wa wa	ter I	)ist <del>r</del> i	ct,		946,300	980,900
Swampscott,2			٠,								5,141	5,510
Saugus,3 .											200	270

<sup>1</sup> No water supplied to these places during the year from Metropolitan Water Works.

<sup>2</sup> Not in the Metropolitan Water District, but has been supplied with water from the Metropolitan Water Works.

<sup>&</sup>lt;sup>8</sup> Only a small portion of Saugus is supplied with water.

Mode of Supply.

25 per cent. by gravity.75 per cent. by pumping.

#### Pumping.

Chestnut Hill High-service Station: -

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used: — Bituminous: Somerset, Orenda, Barnet, Vulcan Steam and Carbon. Anthracite: buckwheat. Price per gross ton in bins: bituminous \$4.09 to \$4.14, buckwheat \$2.97. Average price per gross ton \$3.75. Per cent. ashes, 13.5.

Chestnut Hill Low-service Station: -

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used: — Bituminous: Somerset, Barnet, Orenda and Carbon. Anthracite: buckwheat. Price per gross ton in bins: bituminous \$3.94 to \$4, buckwheat \$2.87. Average price per gross ton \$3.75. Per cent. ashes, 14.0.

Spot Pond Station: -

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used: —Bituminous: Georges Creek Cumberland. Anthracite: screenings. Price per gross ton in bins: bituminous \$4.35 and \$5, screenings \$2.24. Average price per gross ton \$4.02. Per cent. ashes, 13.0.

						CHRSTNU	T HILL HIGH STATION.	I-SERVICE
						Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.
Daily pumping capacity (gallons), .						16,000,000	20,000,000	30,000,000
Coal consumed for year (pounds), .						3,639,708	208,364	8,961,000
Cost of pumping, figured on pumping sta	tion	exp	ense	в, .		\$13,702.08	\$1,885.23	\$32,423.12
Total pumpage for year, corrected for sli	p (m	illio	n gal	lons	),.	2,235.69	209.93	10,852.97
Average dynamic head (feet),						121.65	129.16	131.79
Gallons pumped per pound of coal, .						614.25	1,007.52	1,211.13
Duty on basis of plunger displacement,						64,180,000	117,180,000	137,050,000
Cost per million gallons raised to reservo	ir,					\$6.129	\$8.980	<b>2.987</b>
Cost per million gallons raised one foot,						0.050	0.070	0.023

						CHESTRUT HILL LOW-SERVICE STATION.	SPOT POND STATION.
						Engines Nos. 5, 6 and 7.	Engines Nos. 8 and 9.
Daily pumping capacity (gallons), .		•				105,000,000	80,000,000
Coal consumed for year (pounds), .			•			9,057,261	2,816,358
Cost of pumping, figured on pumping sta	tion	expe	nse	в, .		\$35,378.97	\$14,249.00
Total pumpage for year, corrected for sli	p (n	illio	n ga	llons	),.	21,198.08	3,267.82
Average dynamic head (feet),						54.70	129.76
Gallons pumped per pound of coal, .						2,340.45	2,106.28
Duty on basis of plunger displacement,		• .				109,890,000	129,850,000
Cost per million gallons raised to reserve	ir,		. •			\$1.669	\$4.860
Cost per million gallons raised one foot,						0.081	0.084

## Consumption.

Estimated total population of the nineteen cities an	d t	owns	sup	-	
plied wholly or partially during the year 1907, .					934,730
Total consumption (gallons), pump basis,					45,650,960,000
Average daily consumption (gallons), pump basis,					125,071,000
Gallons per day to each inhabitant, pump basis, .					133.8

#### Distribution.

					-					Owned and operated by Metropolitan Water and Sewerage Board.	Total in District supplied by Metropolitan Water Works.
Kinds of pipe used,				•		•				_1	_ 2
Sizes,	•					•				60 to 6 inch.	60 to 4 inch.
Extensions, less length	aba	ındo	ned (	mile	3),					.09	18.17
Length in use (miles),								·		83.89	1,548.28
Stop gates added, .										6	-
Stop gates now in use,					.•	٠.				867	-
Service pipes added,										-	1,934
Service pipes now in u	se,									-	152,992
Meters added,		•	٠.					•		-	4,334
Meters now in use, .										<b>-</b> .	26,567
Fire hydrants added,								•		-	137
Fire hydrants now in u	se,	•	•	•		•	•	•	•	-	13,827

<sup>&</sup>lt;sup>1</sup> Cast-iron and cement-lined wrought iron.

<sup>&</sup>lt;sup>2</sup> Cast-iron, cement-lined wrought iron and kalamine.

## APPENDIX No. 4.

#### CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1.	2.	8.	AMOUNT	or Bid.	6.
	Num- ber of Con- tract.	WORK.	Num- ber of Bids.	4. Next to Low- est.	5. Lowest.	Contractor.
1	51 1	Section 64, Malden Extension, 42-inch and 54-inch diameter, and 28-inch by 42-inch concrete sewer in trench.	4	\$39,388 50	\$33,577 80 °	T. H. Gill & Co., Boston.
2	58 1	Bulkhead in Chelsea Creek near Chelsea Street Bridge, East Boston.	4	4,218 00	8,830 00 2	Lawler Bros., Boston.

#### Contracts relating to the

8	521	Two horizontal return tubular bollers with ma- sonry settings and con- necting smoke flue for the Quincy station.	2	\$4,295 00	\$3,850 00 s	Robb-Mumford Boiler Co., Boston.
4	53 1	Section 84, Extension of the High-level Sewer, Brookline and Brighton, 69-inch by 72-inch con- crete sewer in trench.	14	40,550 00	39,431 00 *	D. F. O'Connell, Boston.
5	541	Part of Section 83, Extension of the High-level Sewer, Brookline, 69- inch by 72-inch concrete sewer in earth tunnel.	- 8	27,500 00	25,500 00 2	Chas. G. Craib & Co., Winthrop, Mass.
6	55 1	Part of Section 82, Extension of the High-level Sewer, Brookline, 75- inch by 78-inch brick and concrete sewer in trench.	7	44,430 00 2	40,320 00	T. J. O'Connell, Boston.
7	56 1	Part of Section 82, Extension of the High-level Sewer, Brookline, 78-inch by 84-inch brick and concrete sewer in trench and tunnel.	. 6	44,535 00	43,850 00 2	Jas. Driscoll & Son, Brookline, Mass.

<sup>&</sup>lt;sup>1</sup> Contract completed.

<sup>&</sup>lt;sup>2</sup> Contract based upon this bid.

# APPENDIX No. 4.

## THE YEAR 1907. - SEWERAGE WORKS.

## North Metropolitan System.

7. Date of Contract.	Date of Completion of Work.	9. Prices of Principal Items of Contracts made in 1907.	Value of Work done Decem- ber 31, 1907.	
Aug. 8, 1906,	Jan. 5, 1907,	- '	\$40,205 25	1,
July 16, 1907,	Sept. 4, 1907,	For bulkhead complete and for furnishing all the labor, materials, tools, appliances and other necessary plant, including all incidental work, \$9 per linear foot of bulkhead.	3,281 00	2

## South Metropolitan System.

Aug. 31, 1906,	Feb. 12, 1907,		<b>\$3,850 00</b>	8
Apr. 9, 1907,	Dec. 17, 1907,	For earth excavation and refill for 69-inch by 72-inch sewer in trench, \$5.50 per linear foot; for Portland cement brick masonry, \$16.50 per cubic yard; for Portland cement concrete masonry, \$8.32 per cubic yard; reinforced concrete piles in place, \$0.85 per linear foot; rock excavation in trench, \$5 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	41,096 34	4
Apr. 10, 1907,	Dec. 9, 1907,	For earth excavation and refill for 69 inch by 72-inch sewer in tunnel, \$16 per linear foot; for Portland cement brick masonry in tunnel shafts, \$14 per cubic yard; for Portland cement concrete masonry, \$10 per cubic yard.	<b>\$26,501 00</b>	5
May 29, 1907,	Dec. 30, 1907,	For earth excavation and refill for 75-inch by 78-inch sewer in trench, \$13 per linear foot; for Portland cement brick masonry in trench, \$15 per cubic yard; for Portland cement concrete masonry in trench, \$8.25 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	45,621 66	6
May 21, 1907,	Dec. 18, 1907,	For earth excavation and refill for 78-inch by 84-inch sewer in trench, \$12.50 per linear foot; for earth excavation and refill in tunnel, \$25 per linear foot; for Portland cement brick masonry in trench, \$14 per cubic yard; for Portland cement concrete masonry in trench and tunnel, \$7.50 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	43,242 23	7

#### CONTRACTS MADE AND PENDING DURING THE

Contracts relating to the South

	1.	2.	8.	AMOUNT	of Bid.	6.
	Num- ber of Con- tract.	WORK.	Num- ber of Bids.	4. Next to Low- est.	5. Lowest.	Contractor.
1	57	Part of Section 82, Extension of the High-level Sewer, Brookline, 78- inch by 84-inch concrete sewer in trench.	9	\$30,415 00	\$80,412 50°	T. J. O'Connell, Boston.
2	60	Part of Section 81, Exten- sion of the High-level Sewer, Brookline, 78- inch by 84-inch concrete sewer in trench.	9	57,450 00	58,980 00 º	Bruno & Petitti, Boston.
8	61	Part of Section 81, Extension of the High-level Sewer, Brookline, 78-inch by 84-inch concrete sewer in trench and tunnel.	5	56,690 00	58,100 00 2	Hugh Nawn Contracting Co., Boston.
4	62	Part of Section 83, Exten- sion of the High-level Sewer, Brookline, 69- inch by 72-inch concrete sewer in tunnel.	6	59,980 00	54,672 00 °2	T. J. O'Connell, Boston.
5	63	Part of Section 85, Extension of the High-level Sewer, Brighton, 69-inch by 72-inch concrete sewer in tunnel.	8	51,056 00	50,856 00 2	Geo. M. Bryne Company, Boston.
6	64	Part of Section 85, Extension of the High-level Sewer, Brighton, 69-inch by 72-inch concrete sewer in tunnel.	6	94,150 00	92,400 00 <sup>2</sup>	D. F. O'Connell Co. Boston.
<b>7</b>	65	Part of Section 85, Extension of the High-level Sewer, Brighton, 69-inch by 72-inch concrete sewer in tunnel.	3	71,400 00	67,450 00 <sup>2</sup>	Hugh Nawn Contracting Co., Boston.

<sup>&</sup>lt;sup>2</sup> Contract based upon this bid.

Year 1907 — Sewerage Works — Continued.

Metropolitan System — Concluded.

7.	8.	9.	10.	
Date of Contract.	Date of Completion of Work.	Prices of Principal Items of Contracts made in 1907.	Value of Work done Decem- ber 31, 1907.	
July 9, 1907,	-	For earth excavation and refill for 78-inch by 84-inch sewer in trench, \$8.75 per linear foot; for Portland cement brick masonry in manholes, \$16 per cubic yard; for Portland cement concrete masonry in trench, \$8 per cubic yard; for rock excavation in trench, \$6 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	\$30,782 61	1
Nov. 23, 1907,	-	For earth excavation and refill for 78-inch by 84-inch sewer in trench, \$9.50 per linear foot; for Portland cement brick masonry, in manholes, \$15 per cubic yard; for Portland cement masonry, in trench, \$8.50 per cubic yard; for rock excavation, in trench, \$3.50 per cubic yard; spruce lumber in place, \$20 per M feet B.M.	-	
Nov. 25, 1907,	-	For earth and rock excavation and refill for 78-inch by 84-inch sewer in tunnel, \$29.50 per linear foot; for earth and rock excavation and refill in trench, \$12 per linear foot; for Portland cement brick masonry in manholes and tunnel shaft, \$18 per cubic yard; for Portland cement concrete masonry in trench, \$8 per cubic yard; for Portland cement concrete masonry in trench, \$8 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard; for rock excavation in trench, \$4 per cubic yard; spruce lumber in trench in place, \$20 per M feet B.M.	1,760 00	
Nov. 26, 1907,	-	For earth and rock excavation and refill for 69- inch by 72-inch sewer in tunnel, \$16.75 per linear foot; for Portland cement brick masonry in tunnel shafts, \$16 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard; for rock excavation in tunnel, \$10 per cubic yard.	2,458 90	
Nov. 27, 1907,	-	For rock excavation and refill for 69-inch by 72-inch sewer in tunnel, \$28 per linear foot; for Portland cement brick masonry in tunnel shafts, \$16 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard.	-	
Nov. 25, 1907,	-	For rock excavation and refill for 69 inch by 72 inch sewer in tunnel, \$28 per linear foot; for Portland cement brick masonry in tunnel shafts, \$20 per cubic yard; for Portland cement concrete masonry in tunnel, \$10 per cubic yard.	-	•
Nov. 25, 1907,	-	For earth and rock excavation and refill for 69- inch by 72-inch sewer in tunnel, \$30 per linear foot; for Portland cement brick masonry in tunnel shafts, \$17 per cubic yard; for Portland cement concrete masonry in tunnel, \$9 per cubic yard.	-	

Contracts made and pending during the Year 1907 — Sewerage Works — Concluded.

## Summary of Contracts.1

										Value of Work done December 31, 1907.
North Metropolitan System, 2 contracts, South Metropolitan System, 12 contracts,	:	:	:	:		:	:	•	•	\$43,436 25 195,256 84
Total of 14 contracts made and pendir	ır dı	uring	the '	vear	1907.				`.	\$238,693 09

<sup>&</sup>lt;sup>1</sup> In this summary the cost of day work and contracts charged to maintenance are excluded.

## APPENDIX No. 5.

FINANCIAL STATEMENT PRESENTED TO THE GENERAL COURT ON JANUARY 15, 1908.

The Metropolitan Water and Sewerage Board respectfully presents the following abstract of the account of its doings, receipts, expenditures, disbursements, assets and liabilities for the year ending November 30, 1907, in accordance with the provisions of chapter 235 of the Acts of the year 1906.

#### METROPOLITAN WATER WORKS.

The appropriations under the Metropolitan Water Acts, the receipts which are added to these appropriations, the expenditures for the construction and acquisition of works, and the balance available on December 1, 1907, have been as follows:—

Appropriations under Metropolitan Water Acts,	<b>\$40,500,000</b>	00
Receipts from the sales of real estate, and from labor, tools and	•	
supplies, which are placed to the credit of the Metropolitan		
Water Loan Fund: —		
For the year ending November 30, 1907, \$12,410 49		
For the period prior to December 1, 1906, 141,271 51		
	153,682	00
	\$40,653,682	~~
	<b>\$4</b> 0,000,002	w
Amount approved for payment by the Board, out of the Metro-	- , ,	w
Amount approved for payment by the Board, out of the Metropolitan Water Loan Fund:—	- , ,	w
== = * •		00
politan Water Loan Fund:—		00
politan Water Loan Fund: —  For the year ending November 30, 1907, . \$195,680 06		

The amount approved by the Board for maintenance and operation of the Metropolitan Water Works during the year ending November 30, 1907, was \$386,744.17.

Sums received from sales of water to municipalities not belonging to the District and to water companies, and from municipalities for admission to the District, have been applied as follows:—

\$17,437 95

6,128,585 21

\$31,995 97

**\$6,178,019 13 \$6,146,023 16** 

System: -

For the period prior to December 1, 1906, distributed to the cities and towns of the District, as provided by section 3 of the Metropolitan Water Act,	<b>\$219,865 65</b>
Acts of 1907,	7,156 43
	\$227,022 <b>08</b>
The Board has also received the following sums from reproducts and other sources, which, according to section 18 of politan Water Act, are applied by the Treasurer of the Conto the payment of interest on the Metropolitan Water Losing fund requirements, and expenses of maintenance and oworks:—	the Metro- monwealth n, to sink-
For the year ending November 30, 1907,	\$7,986 15 130,832 04
	<b>\$</b> 138,818 19
METROPOLITAN SEWERAGE WORKS.	
The appropriations for the construction of the Metropolita Works, the receipts which are added to the appropriations, a penditures for construction, are given below, as follows:—	_
NORTH METROPOLITAN SYSTEM.	
Appropriations under the various acts, including those for the Revere, Belmont and Malden exten-	
sions,	

For the year ending November 30, 1907, .

For the period prior to December 1, 1906, .

Balance North Metropolitan System Dec. 1, 1907,

 $<sup>^{\</sup>rm 1}$  The word "Board" refers to the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board.

## SOUTH METROPOLITAN SYSTEM.

SOUTH METROPOLITAN SYSTEM.	
Charles River Valley Sewer.	
Appropriations under the various acts, \$800,046 27  Amount approved by the Metropolitan Sewerage  Commission for payment on account of the Charles	
River Valley Sewer,	\$800,046 27
Neponset Valley Sewer.	
Appropriations under the various acts, \$904,000 00 Receipts for pumping, which are placed to the credit	
of the South Metropolitan System, 109 50	
Amount approved by the Board for payment on	
account of the Neponset Valley Sewer: —	
For the year ending November 30, 1907,	_
For the period prior to December 1, 1906,	911,531 46
High-level Sewer and Extension.	
Appropriations under the various acts, \$7,163,000 00	
Receipts from sales of real estate and from miscella-	
neous sources, which are placed to the credit of	
the South Metropolitan System:—	
For the year ending November 30, 1907, 474 28	
For the period prior to December 1, 1906, 6,768 97	
Amount approved by the Board for payments on	
account of the High-level Sewer and Extension: —	
For the year ending November 30, 1907,	478,342 78
For the period prior to December 1, 1906,	5,961,235 24
\$8,874,399 02	\$8,151,155 <b>75</b>
Balance, South Metropolitan System, Dec. 1, 1907,	<b>\$</b> 723,243 27
The the maintainer of second con-	1
For the maintenance and operation of sewerage works an	
priations are made. The balances, appropriations and exper	iditures for
the year ending November 30, 1907, are as follows: —	
Maintenance of North Metropolitan System.	•
Appropriated for the year ending November 30, 1907,	<b>\$143,000 00</b>
Receipts from pumping and from other sources, which are re-	
turned to the appropriation: —	
For the year ending November 30, 1907,	1,220 54
Amount annuared for nermont by the Board	<b>\$144,220 54</b>
Amount approved for payment by the Board: — For the year ending November 30, 1907,	136,641 74
Balance December 1, 1907,	<b>\$</b> 7,578 80

·	
MAINTENANCE OF SOUTH METROPOLITAN SYSTEM.	
Appropriated for the year ending Nov. 30, 1907,	<b>\$100,500 00</b>
Receipts from sales of property and for pumping, which are re-	-
turned to the appropriation: —	
For the year ending November 30, 1907,	12 30
	<b>\$100,512 30</b>
Amount approved for payment by the Board: —	
For the year ending November 30, 1907,	96,157 34
Balance December 1, 1907.	<b>\$</b> 4.354.96

### APPENDIX No. 6.

LEGISLATION OF THE YEAR 1907 AFFECTING THE METRO-POLITAN WATER AND SEWERAGE BOARD.

#### ACTS OF 1907

[CHAPTER 165.]

AN ACT RELATIVE TO ASSESSMENTS FOR THE MAINTENANCE OF THE METROPOLITAN PARK, SEWER AND WATER DISTRICTS.

Be it enacted, etc., as follows:

SECTION 1. Annual appropriations shall be made for the Annual appromaintenance of parks and boulevards under the charge of the priation to be made for the metropolitan park commission, and for the maintenance of maintenance of parks. etc.. the the north and south metropolitan systems of sewerage, and water system for the maintenance of the metropolitan water system under politan sewerthe control of the metropolitan water and sewerage board, and such appropriations shall be apportioned and assessed by the treasurer and receiver general in the manner now provided by law.

age system.

SECTION 2. Of the amount so assessed and collected, any Balance rebalance remaining on the thirtieth day of November in any carried to acyear shall be carried forward to the next year, and shall be ceeding year. taken into account in making the assessments for that year.

SECTION 3. All acts and parts of acts inconsistent with Repeal. this act are hereby repealed.

Section 4. This act shall take effect upon its passage. [Approved March 4, 1907.

#### [CHAPTER 172.]

AN ACT TO APPROVE THE PURCHASE BY THE UNITED STATES OF AMERICA OF A TRACT OF LAND ON DEER ISLAND, IN BOS-TON HARBOR, AND TO CEDE JURISDICTION OVER THE SAME TO THE GENERAL GOVERNMENT.

Be it enacted, etc., as follows:

SECTION 1. The consent of the Commonwealth of Massa-the United States may acchusetts is hereby granted to the United States of America quire a certain

tract of land in Boston harbor.

to the purchase, for fortification purposes, from the city of Boston, of a certain tract of land on Deer Island in Boston harbor, containing a total area of about one hundred acres above mean low water mark; the said tract being marked on the grounds by certain monuments, and being designated on a map entitled "Plan showing land at Deer Island, Boston Harbor, Mass., acquired by the United States under provisions of Act of Congress approved June 25th, 1906", dated United States Engineer Office, Boston, Massachusetts, September twenty-nine, nineteen hundred and six, and signed by Edw. Burr, major, corps of engineers; a copy of said plan with a copy of the deed of conveyance to the United States of the aforesaid land being recorded in Suffolk registry of deeds, book 3177, page 577.

Jurisdiction ceded, includ-ing two strips of land acquired by Commonwealth for sewerage system.

Provided Commonwealth re-tain concurrent jurisdiction.

SECTION 2. Jurisdiction over the tract so purchased, including jurisdiction over the two strips of land lying within the tract described in section one, which were acquired by the Commonwealth of Massachusetts under a taking made by the board of metropolitan sewerage commissioners, dated April 2, 1890, and recorded with Suffolk deeds, book 1928, page 42, the said two strips being the fifth and sixth parcels described in said taking, is hereby ceded to the United States of America: provided, and the cession and consent aforesaid are given upon the express condition that the Commonwealth shall retain concurrent jurisdiction with the United States in and over the lands so purchased, as well as in and over the aforesaid two strips of land lying within the tract described in section one, so far as that all civil processes and such criminal processes as may issue under authority of the Commonwealth against any person or persons charged with crimes committed without the said tract of land, including also the two strips of land aforesaid, may be executed thereon, in the same manner as though this cessation and consent had not been granted.

Certain flats

The United States government is hereby au-SECTION 3. may be occupied and filled thorized, upon such terms and conditions as may be prescribed by the harbor and land commissioners, to occupy and fill such flats belonging to the Commonwealth, and to place such structures in or over the tide water adjacent to the area herein authorized to be purchased as may be necessary for the purposes for which said area is to be used.

SECTION 4. This act shall be void unless a suitable plan Plans to be or plans of the premises purchased by the United States the secretary under the provisions of this act shall be deposited in the office monwealth. of the secretary of the Commonwealth within one year after its passage.

SECTION 5. Nothing contained herein shall abridge or Certain rights of the Commanded the right and title of the Commonwealth in and to the monwealth not shridged two strips of land included in the tract described in section one, and acquired under the taking aforesaid by the board of metropolitan sewerage commissioners, the said two strips being the fifth and sixth parcels described in said taking.

SECTION 6. This act shall take effect upon its passage. [Approved March 6, 1907.

#### [CHAPTER 200.]

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE SOUTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.

Be it enacted, etc., as follows:

SECTION 1. A sum not exceeding one hundred thousand South metrofive hundred dollars is hereby appropriated, to be paid out of of sewage disposal. the South Metropolitan System Maintenance Fund, for the cost of maintenance and operation of the south metropolitan system of sewage disposal, comprising a part of Boston, the cities of Newton and Waltham, and the towns of Brookline, Watertown, Dedham, Hyde Park and Milton, during the fiscal year ending on the thirtieth day of November, nineteen hundred and seven.

oolitan system

SECTION 2. This act shall take effect upon its passage. [Approved March 14, 1907.

#### [CHAPTER 201.]

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE NORTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.

Be it enacted, etc., as follows:

SECTION 1. A sum not exceeding one hundred and forty- North metrothree thousand dollars is hereby appropriated, to be paid out of sewage disposal. of the North Metropolitan System Maintenance Fund, for the

maintenance and operation of the system of sewage disposal for the cities and towns included in what is known as the north metropolitan system, during the fiscal year ending on the thirtieth day of November, nineteen hundred and seven.

SECTION 2. This act shall take effect upon its passage. [Approved March 14, 1907.

#### [CHAPTER 238.]

AN ACT RELATIVE TO THE DISPOSITION OF MONEY RECEIVED FOR WATER FURNISHED OUTSIDE OF THE METROPOLITAN DIS-TRICT BY THE METROPOLITAN WATER AND SEWERAGE BOARD.

Be it enacted, etc., as follows:

Disposition of money received for water outside of the metropolitan district, etc. SECTION 1. All sums of money which shall be paid into the treasury of the Commonwealth by any city or town not belonging to the metropolitan water district, or by a water company in any such city or town, for water furnished under the provisions of section three of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, and acts in amendment thereof, shall hereafter be applied by the treasurer and receiver general to the sinking fund established for the payment of bonds issued on account of the metropolitan water district.

SECTION 2. This act shall take effect upon its passage. [Approved March 22, 1907.

#### [CHAPTER 269.]

AN ACT RELATIVE TO THE HOURS OF LABOR OF WORKMEN, MECHANICS AND ENGINEERS.

Be it enacted, etc., as follows:

1906, 517, § 1, amended.

Section 1. Section one of chapter five hundred and seventeen of the acts of the year nineteen hundred and six is hereby amended by inserting after the word "Laws", in the sixth line, the following: — No laborer, workman or mechanic so employed shall be requested or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week except in cases of extraordinary emergency. Only a case of danger to property, to life, to public safety or to public health shall be considered a case of ex-

traordinary emergency within the meaning of this section. Engineers shall be considered mechanics within the meaning of this act, — and by adding at the end of the section the words: — Threat of loss of employment or threat to obstruct or prevent the obtaining of employment, or threat to refrain from employing in the future shall be considered requiring, within the meaning of this section, — so as to read as follows: - Section 1. Eight hours shall constitute a day's work Eight hours for all laborers, workmen and mechanics now or hereafter day's work for employed by or on behalf of the Commonwealth, or of any ployees, etc. county therein, or of any city or town which has accepted the provisions of section twenty of chapter one hundred and six of the Revised Laws. No laborer, workman or mechanic so employed shall be requested or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one week except in cases of extraordinary emergency. Only a case of danger to property, to life, to public safety or to public health shall be considered a case of extraordinary emergency within the meaning of this section. Engineers shall be considered mechanics within the meaning of this act. But in cases where a Saturday half-holiday is given the hours of labor upon the other working days of the week may be increased sufficiently to make a total of fortyeight hours for the week's work. Threat of loss of employment or threat to obstruct or prevent the obtaining of employment, or threat to refrain from employing in the future shall be considered requiring, within the meaning of this section.

Section two of said chapter five hundred and 1906, 517, § 2, SECTION 2. seventeen is hereby amended by inserting after the word "mechanic", in the eighth line, the words: - working within this Commonwealth, — and by inserting after the word "be". in the eleventh line, the words: - requested or, - and by adding at the end of the section the words: — and every such contract which does not contain this stipulation shall be null and void, — so as to read as follows: — Section 2. contract, excluding contracts for the purchase of material or supplies, to which the Commonwealth, or of any county therein, or of any city or town which has accepted the provisions of section twenty of chapter one hundred and six of

the Revised Laws, is a party which may involve the employment of laborers, workmen or mechanics shall contain a stipu-

Every Contracts void if they do not contain eight hour provision. lation that no laborer, workman or mechanic working within this Commonwealth in the employ of the contractor, sub-contractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract shall be requested or required to work more than eight hours in any one calendar day and every such contract which does not contain this stipulation shall be null and void.

1906, 517, § 4, amended.

Section 3. Section four of said chapter five hundred and seventeen is hereby amended by inserting before the word "Any", in the first line, the words: — Any person or contractor or subcontractor, or any agent or person acting on behalf of any contractor or subcontractor, or, — so as to read as follows: — Section 4. Any person or contractor or subcontractor, or any agent or person acting on behalf of any contractor or subcontractor, or any agent or official of the Commonwealth or of any county, city or town who violates any provision of this act shall be subject to a penalty of fifty dollars for each offence. [Approved April 3, 1907.

Penalty.

#### [CHAPTER 349.]

AN ACT RELATIVE TO SUPPLYING CERTAIN CITIES AND TOWNS WITH WATER FROM THE METROPOLITAN WATER SYSTEM.

Be it enacted, etc., as follows:

1895, 488, § 3, etc., amended.

SECTION 1. Section three of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, as amended by chapter three hundred and ninetytwo of the acts of the year eighteen hundred and ninetyeight, and by chapter three hundred and forty-nine of the acts of the year eighteen hundred and ninety-nine, is hereby further amended by inserting after the word "and", in the twenty-seventh line, the words: - in case of fire or other emergency, - and by striking out the word "other", in the twenty-eighth line, — so as to read as follows: — Section 3. Said board, acting for the Commonwealth, shall construct, maintain and operate a system of metropolitan water works substantially in accordance with the plans and recommendations of the state board of health, contained in their report to the legislature of the year eighteen hundred and ninetyfive, and shall provide thereby a sufficient supply of pure

To construct, etc., a system of metropolitan water works, etc.

water for the following named cities and towns, and the inhabitants thereof, to wit: - The cities of Boston, Chelsea, Metropolitan Everett, Malden, Medford, Newton and Somerville, and the towns of Belmont, Hyde Park, Melrose, Revere, Watertown and Winthrop, which cities and towns shall constitute the Metropolitan Water District; shall secure and protect the purity of said water; shall on application furnish water to any city or town aforesaid that at the time of application owns its water pipe system; shall on application admit any Certain other other city or town, any part of which is within ten miles of towns may be the state house, into said water district, and furnish water to the same on the terms prescribed by this act for the cities and towns aforesaid, and on such payment of money as said board may determine; shall on application furnish water to any water company owning the water pipe system in any town within said ten miles, on such water company assuming the assessments of the town, if any, and making such payment of money as said board may determine; and in case of fire or Water may be other emergency may from time to time furnish water to any city, town or water company, on such payment of money as said board may determine: provided, that any such city or Proviso. town last referred to shall first have acquired the works of any water company therein situated, constructed for the purpose of supplying said city or town or its inhabitants with water. All payments of money aforesaid shall be distributed to the cities and towns in said district in proportion to the total amount of the annual assessments theretofore paid by them respectively. Said board shall furnish said water to the city, town or company, by delivering the same into a main water pipe, reservoir or tank of the city, town or company, under sufficient pressure for use without local pumping, unless delivered in some other manner by mutual agreement between the parties interested; and shall have the direction and control of the connections between the metropolitan and local systems. Said board may utilize the fall of water at any dam under their charge, and may thereby produce power or electricity, and may transmit such power or electricity by pipes, wires or other suitable means, and sell the same, or the right to use such water, by written or other contract, to run for a term not exceeding fifteen years. Any person or corporation authorized by said board shall have all

supplied in

the powers relating to the production, sale and transmission of power and electricity given by this act to said board.

Section 2. This act shall take effect upon its passage. [Approved May 3, 1907.

#### [CHAPTER 458.]

AN ACT RELATIVE TO THE RETIREMENT OF CERTAIN VETERANS IN THE SERVICE OF THE COMMONWEALTH.

Be it enacted, etc., as follows:

Retirement of certain vet-erans of the civil war.

Proviso

SECTION 1. A veteran of the civil war in the service of the Commonwealth, if incapacitated for active duty, shall be retired from active service, with the consent of the governor, at one half the rate of compensation paid to him when in active. service, to be paid out of the treasury of the Commonwealth: provided, that no veteran shall be entitled to be retired under the provisions of this act unless he shall have been in the service of the Commonwealth at least ten years. But if, in the opinion of the governor and council, any veteran of the civil war in said service is incapacitated to such a degree as to render his retirement necessary for the good of the service, he may so be retired at any time. A veteran retired under the provisions of this act, whose term of service was for a fixed number of years, shall be entitled to the benefits of the act without reappointment.

SECTION 2. This act shall take effect upon its passage. [Approved May 28, 1907.

#### [CHAPTER 464.]

AN ACT RELATIVE TO THE CONSTRUCTION OF SEWERS AND DRAINS BY CERTAIN CITIES AND TOWNS.

Be it enacted, etc., as follows:

1903, 383, § 3, amended.

SECTION 1. Section three of chapter three hundred and eighty-three of the acts of the year nineteen hundred and three is hereby amended by inserting after the word "town", in the first line, the words: - except the city of Boston, so as to read as follows: - Section 3. Any city or town, except the city of Boston, using any metropolitan sewer may, to expending certain per cent in any year, and shall in any year specified by the officer or for new sewers, board having charge of said sewers, expend one twentieth of

Boston excepted in pro-vision relative

one per cent of its taxable valuation, to be met by loan outside the debt limit, in the construction, in connection with said sewers, of branch intercepting sewers, connections of existing sewers with intercepting sewers, branch drains, sewers, or drains in any street where one thereof only shall have been built, and the necessary connections aforesaid.

This act shall take effect upon its passage. SECTION 2. [Approved May 29, 1907.

#### [CHAPTER 467.]

AN ACT TO AUTHORIZE THE STATE BOARD OF HEALTH TO DELE-GATE CERTAIN AUTHORITY TO BOARDS OF HEALTH, WATER BOARDS AND WATER COMMISSIONERS IN CITIES AND TOWNS.

Be it enacted, etc., as follows:

SECTION 1. Section one hundred and thirteen of chapter R. L. 75, § 113, seventy-five of the Revised Laws is hereby amended by adding thereto the following: - Said board may delegate the granting and withholding of any permit required by such rules or regulations to state boards and commissions and to selectmen in towns and to boards of health, water boards and water commissioners in cities and towns, to be exercised by such selectmen, boards and commissions, subject to such recommendation and direction as shall be given from time to time by the state board of health; and upon complaint of any person interested said board shall investigate the granting or withholding of any such permit and make such orders relative thereto as it may deem necessary for the protection of the public health, — so as to read as follows: — Section 113. Said board may cause examinations of such waters to be made to ascertain their purity and fitness for domestic use or their sions, etc., the granting, etc., the biability to impair the interests of the public or of persons of permits. liability to impair the interests of the public or of persons lawfully using them or to imperil the public health. It may make rules and regulations to prevent the pollution and to secure the sanitary protection, of all such waters as are used as sources of water supply. Said board may delegate the granting and withholding of any permit required by such rules or regulations to state boards and commissions and to selectmen in towns and to boards of health, water boards and water commissioners in cities and towns, to be exercised by such selectmen, boards and commissions, subject to such rec-

State board of health may

ommendation and direction as shall be given from time to time by the state board of health; and upon complaint of any person interested said board shall investigate the granting or withholding of any such permit and make such orders relative thereto as it may deem necessary for the protection of the public health.

SECTION 2. This act shall take effect upon its passage. [Approved May 29, 1907.

#### [CHAPTER 524.]

An Act to prevent waste of water in cities and towns supplied from the sources or works of the metro-politan water district.

Be it enacted, etc., as follows:

Certain cities and towns to equip water service with meters, etc.

SECTION 1. All cities, towns, districts or corporations which derive all or any part of their water supply from the metropolitan water works or from sources used by or under the control of the metropolitan water district shall after December thirty-first, nineteen hundred and seven, equip with water meters all water services thereafter installed for them, and shall also annually equip with water meters five per cent of the water services which were unmetered on December thirty-first, nineteen hundred and seven; and shall also thereafter charge each consumer in proportion to the amount of water used: provided, that no city, town or district shall, in any one year, contract for more than the number of meters to be installed by it during that year under the provisions of this act; and provided, also, that a minimum rate may be fixed for which the consumer shall be entitled to a stated quantity of water.

Provisos.

How provisions of act shall apply.

Section 2. The provisions of this act shall not apply to the water service for fire purposes only of any city, town, fire district or individual, nor shall such service be taken into consideration in computing metered water service. All water used for the supply of public buildings or other premises under the control of a city, town or district, and all water used from the public works for the flushing of sewers, watering of streets and all other purposes, except for the extinguishment of fires, may be paid for by the city, town or district.

SECTION 3. Meters shall receive the necessary care and Care and maintenance to secure proper efficiency and shall be tested or meters, etc. replaced by the city, town, district or water company whenever there is reason to believe that the records furnished by them are inaccurate, or whenever the service furnished is in other respects inefficient. Cities, towns, districts and corporations may make rules and regulations relative to the care, maintenance and protection of meters, and for properly ascertaining and recording the amount of water actually used during specified periods by each water consumer. Proceed- Proceedings for enforcement. ings for the enforcement of this act shall be instituted and prosecuted by the attorney-general upon complaint of any party in interest.

This act shall take effect upon its passage. [Approved June 15, 1907.

#### [CHAPTER 570.]

AN ACT RELATIVE TO THE HOURS OF LABOR OF LABORERS, WORKMEN AND MECHANICS.

Be it enacted, etc., as follows:

SECTION 1. Section one of chapter five hundred and seven-1906, 517, § 1, etc., amended. teen of the acts of the year nineteen hundred and six, as amended by section one of chapter two hundred and sixtynine of the acts of the year nineteen hundred and seven, is hereby further amended by striking out the word "Saturday", in the thirteenth line, and inserting in place thereof the word: - weekly, - and by adding at the end of the section the words: - This section shall not apply to persons employed in any state, county or municipal institution, on the farm, or in the care of the grounds, in the stable, in the domestic or kitchen and dining-room service, or in storerooms and offices, — so as to read as follows: — Section 1. Eight hours to Eight hours shall constitute a day's work for all laborers, day's work for public empulsion. workmen and mechanics now or hereafter employed by or on ployees, etc. behalf of the Commonwealth, or of any county therein, or of any city or town which has accepted the provisions of section twenty of chapter one hundred and six of the Revised Laws. No laborer, workman or mechanic so employed shall be requested or required to work more than eight hours in any one calendar day or more than forty-eight hours in any one

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